AgroBorealis

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School of Agriculture and Land Resources Management
Agricultural and Forestry Experiment Station

This issue of Agroborealis offers a snapshot of the diversity of the tripartite mission of SALRM/AFES in research, teaching, and service to the citizens of Alaska. The University of Alaska Fairbanks has long recognized the importance of interacting and providing resources to Alaska's youth in K–12, 4–H and FFA. We recognize them as our future students and Alaska's future leaders.

Articles that follow highlight a few of the programs promoted by faculty and staff of SALRM/AFES that provide educational opportunities for youth from preschool through early elementary to science and leadership training for middle and high school students.

Our Georgeson Botanical Garden provides the backdrop of programs ranging from flora and fauna of constructed wetlands to plant science field trips, youth employment training, and resources apprenticeship programs. These programs, working cooperatively with local K–12 teachers and parents, challenge our young people to better understand the science that supports the wise management and sustainable development of our vast natural resources in agriculture, forestry, and other land based resources.

Another article describes the partnership between our school and agricultural and natural resources youth programs, Future Farmers of America (FFA). The long–standing national program fosters leadership and science training among high school–age students. Success of the FFA partnership can be measured in the number of former FFA members who have completed degree programs at UAF and are now employees in related occupations. Whether in natural resources or other fields, communication skills learned in FFA have served them well. Although there were FFA programs in Alaska prior to 1976, that was the year that the Alaska State FFA Association was granted a charter by the national association. Since that year, the Alaska FFA Association has sponsored an annual convention with career development and leadership events including judging contests. The annual conventions in the 1980s were hosted by the SALRM and the University of Alaska Fairbanks, the original Land Grant College of Alaska. Following several years of holding the state convention in several locations throughout Alaska, the state FFA association has held the last two conventions at the University of Alaska Fairbanks. This relationship of the FFA and the State Land Grant College is similar to programs in other states. The faculty, staff and students of SALRM are pleased to have reaffirmed this association and are honored to host the annual convention as well as the annual meeting of State FFA Association officers at the agricultural youth leadership development program.

Finally, this edition presents results from three long–term research programs in forestry and resource reclamation that demonstrate long–term sustainability of both renewable and nonrenewable resources development and conservation.

G. Allen Mitchell

EDITORIAL STAFF

Interim Dean .... Fredric M. Husby
Interim Director .... G. Allen Mitchell
Editor .... Jan Hanscom

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Agroborealis Contents

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Front Cover: One fine sunny day this vase turned up on the deck at the pond in the Georgeson Botanical Garden. No one knew who had donated it to the garden for several weeks but it just seemed to fit. Whimsical garden ornaments hidden in various places around the garden are a dream of Dr. Pat Holloway's. She says it would certainly add a fun surprise to come across a laughing pig or a hidden frog as you walk through the garden.

Back Cover: Dr. Glenn Juday shares information gathered from the Rosie Creek Burn Project and from Bonanza Creek LTER with fire control specialists and forest managers from Russia. As the result of these meetings in 1994 a cooperative agreement was worked out to share information regarding fires and to provide fire–fighting help for either country if the need arose.

Wetlands and Botanical Gardens: An educational opportunity

by Jan Hanscom, compositor

photo by Pat Holloway

Occasionally the pond at the Georgeson Botanical Garden is a place of peace and quiet reflection.

I was sitting on the deck by the pond eating my lunch when a little bird hopped up to the edge of the pebble beach. This little bird was nervous about me being there, but eventually hopped into the water and took a quick bath before heading back to the neighboring chokecherry trees. I could see all kinds of aquatic insects swimming in the water. There was a little waterfall coming from the hillside into a small stream that fed the pond. The happy sound of the babbling water, tumbling over rocks carefully placed to give just the right music, was very relaxing. The tension and troubles of my morning just seemed to disappear. I sat there enjoying the peace.

Then the calm was shattered. I heard the stomping of little feet and the screams of little voices. They came charging over the bridge and across the bog. They jumped onto the rocks, not following the pathway, not listening to the quiet. They scared the birds away and didn't even notice them. "They" are children.

Children are on the go all the time. The children who designed the pond really wanted a sandy beach to dig and play in, not for the birds to use to hop into the water for a bath. The children wanted a deck to run to and throw sticks into the water not for quiet contemplation. They tear out the cattails, and collect as many water bugs as possible, not really caring if they were all the same or different. They throw rocks into the water just to hear the splash with no thought about what that does to the pond over time.

I don't know what it is exactly about water and children, but there is definitely a connection there that is very strong when we talk about what attracts children in nature. If there is water, they will find it, throw rocks into it, splash in it, hop around it, and almost inevitably fall into it. With that kind of fascination, what better teaching tool is there than a pond?

Many grade–school classes in the Fairbanks area go on camping trips in the spring to Twin Bears Camp or Chena Hot Spring, both of which offer ponds and streams to study wetland and water related topics. These places provide a natural setting for studying the science of water life and have their own protocol for what is appropriate behavior. In nature, ponds are usually large enough to sustain massive collecting of the aquatic life and removal of plant materials. If that is your intention then you

photo by Pat Holloway

Once the calm is shattered, there is something magical about watching children around the pond. They are interested in everything and are always looking for the fish. Every year, goldfish appear in the pond, probably placed there by some obliging parents who also feel a pond should have fish. Some survive for long periods of time and play hide and seek under the decks, making it a fun game to 'find the fish.'

photo by Cal White

On a warm sunny summer day, you will often find young people enjoying the pond. The decks are the perfect place for a picnic lunch and, although we don't encourage jumping onto the rocks, it is an irresistible challenge to some visitors.

should plan a trip to one of those facilities. However, there are many other children whose classes don't get to participate in those types of outdoor activities for a variety of reasons ranging from lack of funds to limited availability of facilities.

A botanical garden is a place filled with demonstrations of the way plants can be used in combination with man–made structures like bridges and decks, to make a beautiful environment with a purpose—to educate. Parents and other adults must accept the responsibility for teaching the youth of today to respect natural areas. We can begin that process by providing places like the Georgeson Botanical Garden and then educating children about how to act appropriately in this wonderful outdoor classroom.

Constructed wetlands provide a great outdoor laboratory for studying environmental conditions for plant growth in gardens and in the wild. The Georgeson Botanical Garden has a ready–made pond. It is a constructed wetland made with a poly liner. In places the pond is only 12 inches deep. Learning how plants survive under these conditions has been a real challenge. For openers, cattails have adapted so well they have had to be thinned out to prevent them from taking over. The warm waters promote a phenomenal algae bloom. Smaller plants, such as the carnivorous bladderwort, have disappeared because we are unable to provide the proper habitat.

Our pond is complete with viewing decks and pond study kits. It is perfect if you have some children unable to negotiate the rough outdoor terrain or you have neither the time nor inclination to take your children camping. Children can't be as free in their behaviors, it is true, but with education about botanical gardens and respecting this garden for what it does offer, children can experience a wonderful bit of nature.

There are two decks large enough to hold four or five children each. They can catch aquatic insects and view water plants. Kits are available to check out in the Georgeson Botanical Garden Gift shop with magnifying glasses, hand held microscopes, and related paraphernalia to view the microscopic and macroscopic pond life close–up. The identification cards that accompany the kit make it easy for young scientists to identify what they are looking at and with the help of adults, an interesting variety of critters can be spotted.

Aquatic Insects

Some examples of aquatic insects in the pond are water bugs, water striders, water boatmen, whirligigs, and predaceous diving beetles. It is great fun to lean over the deck and use one of the tin–can viewers to help spot these insects below water. The identification cards in the kit will help you identify the insects found in the pond and those flying around the pond, like dragon flies and damsel flies. Their nymphs are very interesting for children to look at. Collect a few and observe their mouth parts. It is quite fascinating how they catch their prey. The lower mandible is able to spring out and catch smaller insect larvae. Come at different times during the summer to observe the transition of species as the plant life in the pond comes to life and different food is available.

Snails— not an insect but a mollusc— are the most prevalent critter in the water later in the summer. Algae is readily available and with the plentiful food supply comes plentiful snails.

Alaska Native Water and Bog Plants

The plants are all Alaska native plants collected from the wild. There are cattails, rushes, marsh marigold, heartleaf, arctic cotton, buckbean, wild calla, horsetail, and iris just to name a few.

Curriculum

There are plenty of curricula available, the best one being the wetlands curriculum put out by the U.S. Fish and Wildlife Service. The only problem with that curriculum is, it is hard to get a copy because it has been under revision for several years. There is another nice curriculum available through the Alaska Cooperative Extension and 4–H. It comes with separate books aimed at different grade levels from K–12. Ask them for the series that starts with *Mud, Muck and Other Wonderful Things*. Alaska Fish and Game and the Alaska Public Lands Information Center can also help you think of activities related to ponds and wetlands. Check out the list of references at the end of this article which are available for examination at the Georgeson Botanical Garden Library.

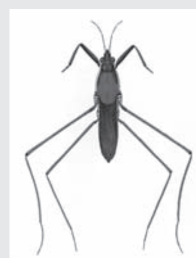
Garden Etiquette

One of the biggest challenges facing the staff at the Georgeson Botanical Garden is how to teach children and their parents ways to interact with the resources provided at the garden while avoiding destruction of those same resources. Often botanical gardens have signs posted around reminding people not to pick the flowers or damage the plants in any way. The Georgeson Botanical Garden staff wants to use positive signs instead of negative signs. For instance,

Aquatic Insects

adult diving beetle and larvae

adult mosquito, pupae, and larvae



water strider

adult whirligig beetle and larvae

water boatman

water bug

These illustrations are not to scale.

a sign might say, “Follow the stepping stones to find your way to the deck.” Keep an eye out and you might start to see signs around the garden that will give garden etiquette hints. It is best to stay on pathways when they are provided. Walking on grass quickly forms compacted soil that kills the grass and leaves a dirt path. Trees are great for climbing but it really isn’t appropriate to do that in a botanical garden. Picking the flowers is such a temptation to the youngsters, and sometimes to me also, that parents must be diligent in monitoring them while in the garden. I think the thing to teach your children when you visit the garden is that we always want to leave a place better than when we came, so pick up a piece of trash or pull a weed and take it with you. That will be truly appreciated by the GBG staff.

Future Plans

It is taking a lot more time than we thought to build the structures, make sure they are all working, figure out what isn’t working and how to fix it, and move on to the next problem. It is an ongoing matter of fixing things that don’t work the way we thought they would. For instance, we thought the bog would filter the water enough to eliminate the need for a biological filter. It turns out this is not so. We have a serious problem with algae late in the summer. It takes over the area of the pond that is supposed to be open water.

The boggy areas need taller stepping stones. The stepping stones need to be made to look like the obvious way to get to the decks so kids will stop walking along the edge of the pond.

The stream needs to be totally dug up and relined higher up the sides to allow more water to flow, thus allowing children to drop things into the water at the first bridge and have enough water volume moving through the stream bed to float things from one bridge to the next.

The building of our pond is a continuing process and over time more and more educational activities will be available for the youngsters. When our pond/wetland area is completed, it will include areas to study aquatic plants, aquatic insects, microscopic water life, water flow and velocity, and water chemistry. The biggest things holding us back in completing this project are labor and funding. Volunteer labor with funding from Alaska Science and Technology Foundation Direct Grant to Teachers started the construction of this pond. Neither the botanical garden staff nor the 4–H and Denali Elementary volunteers had experience in building a facility like this one so we are learning as we go.

The big project for this summer will be to complete the rock wall behind the pond so the waterfall can be completed and the table can be put in place. This will facilitate teachers in bringing students to the pond and provide an area to set up microscopes and look at critters. Once the waterfall is completed, the water in the pond should be aerated better and perhaps flow faster.

If you would like to volunteer to help build the pond or work in other areas in the GBG, call Grant Matheke at 474–6921.

How to build an underwater viewer

Materials needed:

- a number 10 or other large–size can
- rubber bands
- clear plastic wrap
- can opener
- metal file

Method:

- cut both ends off the can
- smooth the edges with the file
- cover one end of the can with clear plastic wrap
- secure the plastic wrap with a rubber band placed around the can
- place the plastic–covered end into the water
- see what is down there

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Educational Outreach at the Georgeson Botanical Garden

by Dr. Patricia S. Holloway, Associate Professor of Horticulture and Grant E.M. Matheke, Horticultural Research Technician

Since 1987, the Georgeson Botanical Garden has provided outreach education in applied plant sciences at the University of Alaska Fairbanks. Our goal is to provide hands–on educational experiences for all ages, from preschool children to senior citizens. Our basic philosophy is to introduce principles of plant science and botany in some familiar, non-threatening settings, i.e. the garden and greenhouse, and progress to more complex laboratory experiences. The program involves extensive use of field trips, one–on–one student experiments, classroom visitations, participation in science fairs and science nights, apprenticeship programs and youth employment training programs. Listed below are some of the current and past programs.

Plant Science Field Trips

The GBG sponsors educational field trips from May through the beginning of October on a diversity of subjects. Preschool children learn about colors, parts of flowers, simple counting exercises, etc. First graders learn about seeds and the parts of a plant. Older children learn about disease/plant interactions, wildlife in the garden, plant reproduction, associations of plants with beneficial organisms, and much more. These programs are tailored to individual teacher needs. Each year, the entire second grade class of University Park Elementary School (about 100 children) visits the garden, learns about seeds and other propagules (i.e. potato tubers), then helps us plant the beans, peas and potatoes in the family food garden. In the past, we brought potatoes that the children planted back to the school for a science night program, and a classroom exercise in economic botany.

AFES photo

Dr. Pat Holloway, above, often goes to schools and assists with plant related science projects.

Students from the Interior come to the farm not just to see the garden. They like to include a tour of the pig barns and a visit to the reindeer pens. Many classes use the lawns and picnic tables for lunch and some have been known to fly kites on the hillside. We recommend calling ahead to get a guided tour of the AFES farm. In the summer call the GBG Gift Shop at 474–1944, at all other times call Larry Burke at 474–7627. There are many requests for tours in the summer so call early. Self–guided tours are available at any time.

photo by Pat Holloway

Students from University Park Elementary, left, visit the garden each spring to help plant.

Summer Classes in the Garden

The GBG offered a series of non–credit classes each summer for adults, children, or parents and children. They were designed to promote a greater appreciation of the environment and broaden knowledge of plants and plant culture. Courses have included floral design for parents and children, vermicomposting, seed gathering for parents and children, garden sketchbook drawing, plant propagation, plant identification, plant pressing, and elementary botany. This program is not available during the summer of 1999, but keep an eye out for this very popular program to resume as soon as adequate funding is obtained.

Adults enjoy the flower arranging classes taught by Cathy Nussbaumer, above.

photos by Pat Holloway

Many classes are offered to children and their parents together. Vermiculture, left, taught by Marsha Hancock, is all about worm composting, while Gail Mayo's class, above top, is on using natural dyes. Children love the pressed flower class, above.

Youth Employment Training Program

We participate in a summer youth employment training program for qualified Fairbanks youth. We train students in skills necessary in the greenhouse, nursery and landscape construction businesses. Skills are pertinent to the largest plant science industry in Alaska, the $30 million greenhouse/nursery/landscape industry, as well as potential employment outside Alaska. This program is funded through the Job Training Partnership Act (JTPA) administered by the State of Alaska, Fairbanks Service district.

Resources Apprenticeship Program

This program, which has been temporarily suspended, was administered by the United States Department of the Interior Bureau of Land Management and funded by grants from agencies such as Tanana Chiefs Conference to provide hands–on training in natural resources management for Alaska Native youth from all over the state. When students express an interest in working at the GBG, we are available to train them in skills ranging from general plant culture to research design, data collection and computer data analysis.

photos by Pat Holloway

These are two of the lucky JTPA students (Geraldo Cruz, above left and Curran Meyers, above right) who worked at the GBG during the summer of 1998. They get their jobs by applying to the Summer Youth Employment Training Program at the State of Alaska offices located on 7th Ave. in Fairbanks.

Alaska Statewide High School Science Symposium Mentoring

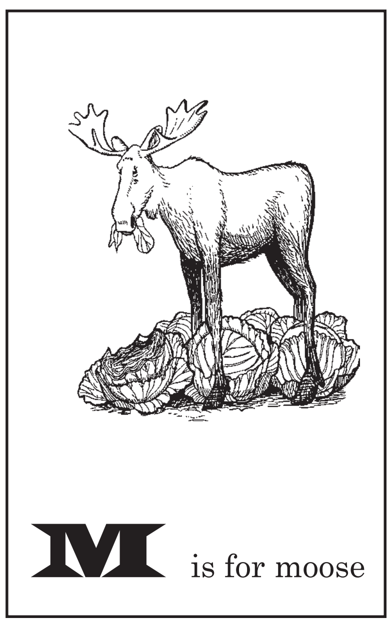
This program, designed by Dr. Gary Laursen, West Valley High School, provides for students to complete original research projects in association with a faculty mentor. The GBG has supported this program by providing laboratory equipment, space, supplies and one–on–one mentoring for one student annually. Past student projects include titles like *Hormonal Control of Organogenesis in Lily Bulb Scales* and *Pollen Viability of Tomato in Relation to Temperature.*

Science in the Garden

The GBG staff will assist any educational group in conducting meaningful experiments in the garden that teach simple methods of experimental design, data collection and analysis. One project involved the Denali 4–H children who were interested in testing landscape mats impregnated with a variety of seeds such as wildflowers. These commercial products were advertised as a fund–raising item for national sales (similar to Girl Scout cookies). The children wanted to learn if these products were worthwhile for Alaska. The 4–H group used the GBG as the testing ground for their experiment, and we assisted in the design and implementation of their project.

Color Your Garden

In 1994, we designed a coloring book for preschool and K–3 students who might visit the garden as part of an educational group. The book is not bound, and educators can copy as many sets as they have children. The purpose of the book is to provide some simple activities for children in the garden including, recognizing different colors, matching pictures with flowers in the garden, flower identification, and observation. We offered it to all child–care centers in the Fairbanks area and all elementary schools. So far, we have sent out 56 packets.



These are examples of the types of pages found in the Georgeson Botanical Garden ABC Coloring Book.

A Day at the Georgeson Botanical Garden

by Jan Hanscom, compositor

The University of Alaska Fairbanks is the site of the Agricultural and Forestry Experiment Station's Fairbanks Farm. For almost 100 years, demonstration gardens have been planted to teach the people of this area ways to raise successful family food gardens. The site is now a popular stop for tourists and local inhabitants during the summer months. Dr. Pat Holloway has worked diligently over the past 10 years to turn the demonstration gardens into an outstanding botanical garden. Once a year, we take great pleasure in showing off our garden by inviting the public to attend "A Day at the Georgeson Botanical Garden."

The way it works is very simple and this method of presenting an event could be easily adapted to other groups. An adult mentor is recruited. This adult is interested in working with teens and has an interest in environmental education activities but we do not assign a specific activity. Instead, the mentor and the teen independently pick a topic — say soils. Then the mentor and teen who chose soils are put in contact with each other. They work together to find appropriate activities to teach youth in grades K–6 about soils. The teen and mentor plan the educational activity, practice the activity, learn how to work with youth in K–6, and provide this educational experience over and over again during the "Day at the GBG." They must plan an activity that will both challenge the older ones and keep the younger kids interested. They have to find all needed materials and make sure they understand their topic well enough to explain it to adults. The adult mentors are often not even present on "A Day at the GBG" day. They have already done their work and the teens are ready to fly on their own.

Every year the activities change but there are some that are so popular we just couldn't do without them. For instance, picnic benches are placed near the pond and microscopes are set up. Jars and nets are available to collect critters from the water. The kids just love looking for living things in the pond.

The tour of the barns is another favorite. It is so exciting to see the baby pigs, feed the reindeer, and pet the cows. Some kids find this the highlight of the day! Whenever possible, we schedule a 4–H petting zoo to coincide so the kids can see other animals and find out what can be raised as part of a 4–H project.

Other activities usually include face painting, nature crafts, composting, insects, potato prints, soils, bees, and another big favorite, scavenger hunts.

We want people to see the garden and realize what a wonderful resource they have in their own town. After hosting this event for the last three years, people now expect it and ask when it will be held. With over 1,000 people attending last year, it truly has become a community event.

The television and newspaper media seem to highlight youth when they are doing bad things. Teens vandalizing schools or stealing make headline news. There is a national campaign right now to encourage teens to volunteer and make a difference in their communities. Well, 4–H teens have been doing that all along and this event is just one example.

There is plenty of room in the hay field across the road from the farm to accommodate vehicles and with the farm grounds shut down to traffic, it is a safe place for the kids to run and play and enjoy the day. This year the date for this wonderful family event is Saturday, July 17. Mark it on your calender and plan on attending.

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The 3rd Circumpolar Agricultural Conference, Anchorage, Alaska

by Dr. Stephen D. Sparrow, Professor of Agronomy
and Dr. Carol E. Lewis, Professor of Resources Management

The 3rd Circumpolar Agricultural Conference was held in Anchorage, Alaska, USA, 12–16 October 1998. Circumpolar Agricultural Conferences bring people together who are interested in high–latitude agriculture. The overall objectives of the conference is to discuss common problems and their potential solutions and to exchange information.

There have been two Circumpolar Agricultural Conferences prior to this conference. The first conference was held in Whitehorse, Yukon Territory, Canada in 1992 and the second in Tromso, Norway in 1995. These conferences outlined strategies for northern agriculture and how agriculture and its development in the North differ from temperate regions. The question the 3rd Circumpolar Agricultural Conference addressed was: "What is the role of circumpolar agriculture in meeting the requirements of northern communities, environmental concerns, and social and cultural issues in an increasingly global economy?" The question centered on its theme "The Challenge of Globalization."

The Circumpolar Agricultural Association

The Circumpolar Agricultural Association sponsors the Circumpolar Agricultural Conferences. The Association solicits and receives support from local industry, governments, agencies, and academic institutions. Members of the association are individual agriculturists and institutions from the circumpolar countries. These include Canada, Finland, Greenland, Iceland, Norway, Russia, Sweden, and in the USA, Alaska. All those interested in agriculture in the circumpolar North are encouraged to become members. The Association defines agriculture broadly to include traditional crop and animal production as well as non–traditional pursuits such as game herding, ranching, farming and subsistence agriculture, controlled environments, revegetation, and aquaculture. Those interested in symbiotic industries such as forestry and mining are welcome.

The 3rd Circumpolar Agricultural Conference

Approximately 120 participants attended the 3rd Circumpolar Agricultural Conference. They came from the eight circumpolar countries and included producers, researchers, agricultural administrators, agency personnel, students, and policy makers. In addition to addressing its theme "The Challenge of Globalization", the conference helped celebrate the 100th anniversary of the agricultural experiment stations in Alaska.

Oral and Poster Sessions and Tours

The conference was organized around volunteered oral and poster sessions that highlighted plants and soils, animal agriculture, land reclamation, and northern community development, policy and marketing. There were over 70 oral presentations and 40 posters. The topics ranged from genetic resources and effects of climate change on plant and animal production to innovative land reclamation techniques for agricultural and industrial lands, to exporting agricultural products, building a healthy agricultural community, globalization barriers and benefits, and the value of research to support northern agriculture.

Three tours allowed participants to learn about agriculture in Alaska and about the state's abundant resources. An experimental greenhouse owned and operated by Abbey Ala, which is used for production and teaching, was a highlight of the pre–conference tour. Tours during the conference traveled to the Matanuska–Susitna Valley, the heartland of south–central Alaska's agricultural industry, where visitors stopped at the State Division of Agriculture's Plant Material Center and the University of Alaska Fairbanks' Palmer Research Center, a part of the Agricultural and Forestry Experiment Station. They also visited urban agricultural enterprises in Anchorage, including the largest creamery in Alaska and a berry product processor.

Keynote and Plenary Speakers

Our keynote speaker, Richard Steinkamp, Assistant to the Director, Agricultural Foreign Service, United States Department of Agriculture, addressed the conference theme. He pointed out the importance of international markets to all agricultural producers, but stated that the value of U.S. agricultural exports was expected to drop in 1999 to 1990 levels. Mr. Steinkamp stressed the importance of new technologies, particularly genetic engineering and biotechnology, to further advances in the production capability of the world's agricultural industry.

Plenary speakers highlighted the oral and poster session themes. They included development of northern communities and their relationship to agriculture, product marketing, controlled environment agriculture, land reclamation, and the value of northern agriculture.

Our first plenary speaker, Ms. Audrey McLaughlin of Whitehorse, Yukon, Canada, spoke to the importance of communities. She emphasized the diversity of the makeup of communities in the North including their cultures, their relatively small size, and their remoteness. Her message stressed the importance of agriculture not only for food production and income, but also for the quality of life it brings to the community and families.

Mr. Joseph Van Treeck, General Manager of Matanuska Maid Dairy, Inc., Anchorage, Alaska, told participants about the importance of developing markets and using proper marketing techniques and strategies. His strong message clearly conveyed the necessity of aggressive marketing for circumpolar producers and processors if they are to succeed.

The U.S. National Aeronatics and Space Administration (NASA) has a great deal to offer for northern agriculture, was the message Dr. David Bubenheim, Ecological Technologies Branch, NASA/Ames, Palo Alto, California, brought to the conference. NASA has done substantial research on plant production and lighting systems and sustaining life in controlled environments. The technologies are appropriate for northern communities and agriculturists.

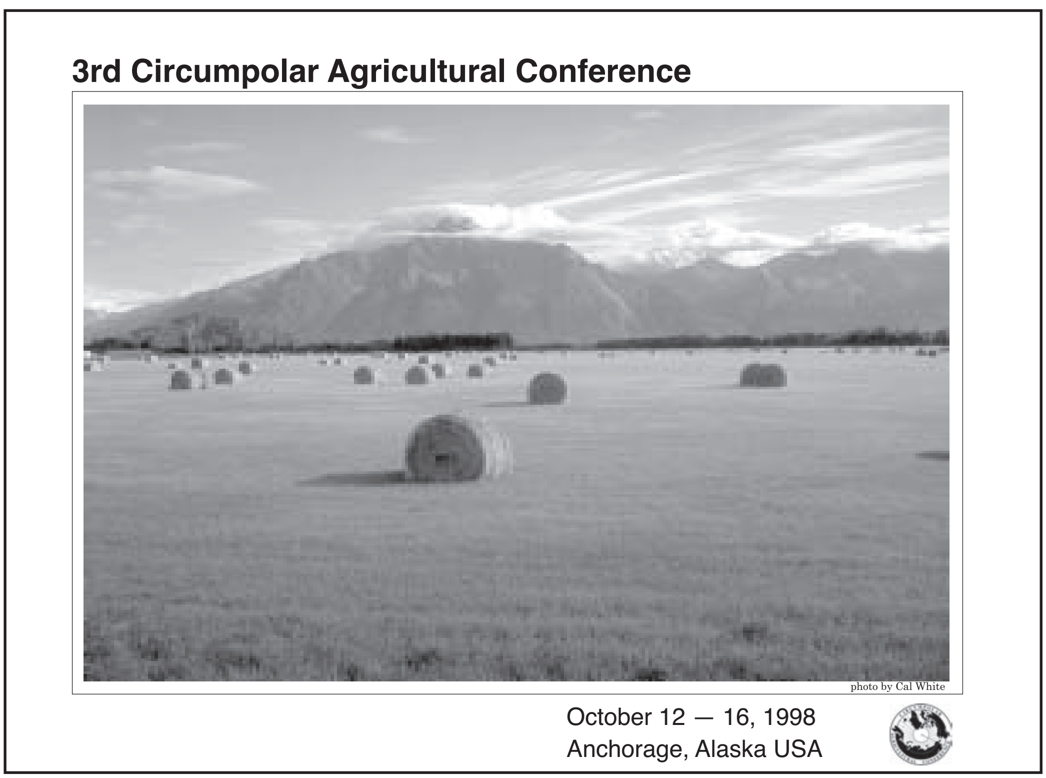
The problems of land reclamation in Iceland are severe. Dr. Borgthor Magnusson, Icelandic Agricultural Research Institute, related some of the problems associated with reclamation of degraded lands in a northern environment, a common problem for most of the circumpolar countries. He gave examples of work he and his colleagues have done to solve reclamation problems.

Our final plenary speaker, Mr. Lars Ericson, of the Swedish Agricultural University in Umeä, Sweden, discussed some of the problems and advantages of producing agricultural commodities in northern regions. He related this to past situations and spoke of the future importance to local economies and the world's economy.

Future Plans and Information

The Circumpolar Agricultural Association past president Hans Kohlben–Dahle announced that the 4th Circumpolar Agricultural Conference would be held in Akureyi, Iceland in 2001. Dr. Thorsteinn Thomasson was presented as the next president of the Association.

A proceedings for papers presented at the 3rd Circumpolar Agricultural Conference is available for a cost of US $15. The color poster, depicted below, is also available for US $10. The proceedings and/or poster can be obtained by contacting:
Stephen D. Sparrow, e–mail: ffsds@uaf.edu, or
Carol E. Lewis, e–mail: ffcel@uaf.edu,
Telephone: (907) 474–5550
Fax: (907) 474–6184



AFES hosts FFA Students:
A partnership for agriscience education

by Jeff Werner, Research Technician
and Dr. Meriam Karlsson, Associate Professor of Horticulture

From cows and plows to agriscience and biotechnology, agricultural education programs, FFA (Future Farmers of America) and the Agricultural and Forestry Experiment Station (AFES) continue to prepare young people for careers in Alaska's agriculture and natural resources. The diversity of agriculture provides many educational and career development opportunities for students from all backgrounds. The FFA organization is an integral part of the agricultural educational program in many high schools.

> *"FFA in Alaska is only possible with the volunteer support of UAF and School of Agriculture and Land Resources Management, and Agricultural and Forestry Experiment Station faculty and staff in Fairbanks and Palmer. Thank you UAF for making a positive difference in the lives of Alaska's young people involved in agriculture and natural resources."*
> Amy Kenley, Alaska State FFA President

FFA, AFES and UAF have been partners in education and training students in leadership and agriscience since the early colonists of the Matanuska Valley. Palmer high school in the Matanuska Valley was the first school to have an agriculture curriculum, where most of the students lived and worked on family farms. During the early years of FFA in Alaska there was much assistance to the organization from researchers at the Agricultural Research Station. Researchers would help teach and demonstrate agriculture topics and assist during judging contests at local fairs.

The School of Agriculture and Land Resources Management has also taken an active role in promoting FFA by providing leadership, educational materials and overseeing the management of the Alaska State FFA Association. Dr. Carla Kirts, as a faculty member of SALRM, assisted the FFA for many years prior to her assignment as Dean of Students at UAF. Today faculty, staff and students of AFES/SALRM continue to assist the Alaska FFA in many capacities. Jeff Werner, AFES research technician, has been the Alaska State FFA Advisor since 1997. Prior to receiving his degree in Natural Resource Management from UAF in 1993, Mr. Werner graduated from Palmer High School where he was active in the agriscience/FFA Program and served as State Vice–President.

AFES hosts the State Convention on the UAF campus in April, and participates by presenting workshops, mentoring, and helping students develop leadership skills. The goal of the Alaska State FFA is to prepare young people for leadership and education in agriculture and natural resources in order to benefit their local communities and Alaska. With the help of AFES, students from across the state are becoming involved in local industries and governmental agencies. From the classroom to careers, the FFA and AFES help students understand available agricultural and natural resource opportunities.

Many students discover career opportunities while in a class, on a field trip, or attending a conference. Students participating in FFA, enroll in agricultural education and are active in their career interests prior to graduation from either high school or college. While attending UAF, the majority of these students maintain their interests and generally find employment in their desired career fields.

Success of the FFA program partnership can be measured in many ways. One important measure is the number of past FFA members who have finished degree programs at UAF and are now employed in related occupations.

The successful partnership between AFES and FFA has resulted in the development, implementation, and participation of many career programs and

photo by Jeff Werner

FFA student from Palmer participates in the state convention floriculture contest.

events. The following are some examples of recent programs made possible by student members of the FFA under the leadership and assistance of the State Advisor at UAF: Alaska State FFA Convention; New State Officer Training; Chapter, Industry and School Visits; Ag Appreciation Day; Alaska State Fair; Tanana Valley Fair; Ag Symposium; and Delta Farm Forum.

photo by Jeff Werner

FFA members participate in flag raising ceremonies before contests at the state convention in Fairbanks.

The Alaska State FFA Association has more than 130 members with local chapters in Anchor Point, Anchorage (Dimond High School), Cordova, Delta Junction, Homer, North Pole and Palmer. The national FFA organization has 449,814 members in 7,241 local chapters throughout all 50 states, Puerto Rico, Guam and the Virgin Islands. Similar numbers of FFA members come from rural, urban and suburban chapters and areas.

The mission of FFA is to make a positive difference in the lives of students by developing their potential for premier leadership, personal growth and career success through agricultural education. The Alaska FFA prepares young people for leadership and careers in the science, business and technology of agriculture and natural resources. Students learn how to give public speeches, conduct meetings and elect officers with guidance from chapter and state advisors. Student officers preside over meetings and lead local chapters, and lead state and national organizations in planning activities, competitions and conventions. In Alaska, six state officers are elected each year. The six state officers travel throughout Alaska and to the lower 48 states for training, to give workshops, to meet with FFA members, and to serve as student representatives for agricultural education to government agencies, business enterprises and community leaders.

Other key components of the FFA experience include personal growth and career success. FFA members help others and in the process learn more about themselves. While reaching out to elementary students in FFA mentoring programs, volunteering in service projects, and meeting students from around the country, members see the world from new perspectives and grow from the experience. FFA members gain responsibility and self–confidence that cannot be taught in a classroom. FFA assists students in exploring the more than 2,000 career fields within the agricultural industry. Hands–on programs and internships give them an early professional experience and head start in college or the work force. The result is a steady stream of prepared, motivated and well–trained employees for agriculture or other industries.

Becoming a leader takes strong personal commitment. FFA programs and activities reveal that education is more than homework and classes. Competitive events provide recognition for members who want to test their talents and strengthen their skills. America is a leader in agricultural production and technology and the global market is full of opportunities. FFA connects members to the limitless possibilities by equipping them with a larger understanding of the surrounding world.

The Alaska FFA represents the State of Alaska, UAF, and the Agricultural Community at the National FFA Convention. Over 48,000 high school students attend the national convention each year.

Program Advisor Receives Honorary Degree

AFES photo

Dr. Meriam Karlsson, Associate Professor of Horticulture, serves as program supervisor of the FFA, contest superintendent and academic advisor. Dr. Karlsson received the Honorary State Degree and Honorary American Degree, the highest degree of the National FFA Organization, during the 1998 National FFA Convention.

Global Learning and Observations to Benefit the Environment

by Dr. Elena Sparrow, Affiliate Associate Professor of Soil Microbiology and Science Education

THE GLOBE PROGRAM®

In 1994, the first U.S. Global Change Education conference brought together scientists and educators from all over the United States to discuss education regarding global change and to share expertise in launching global change curricula across the country. Kindergarten through junior college students and the general public were identified as highest priority audiences. An Alaska team consisting of science teachers (Sandra Pahlke and Steve Hackett), a University of Alaska Fairbanks (UAF) Agricultural and Forestry Experiment Station (AFES) scientist (Elena Sparrow), an educator from the Alaska State Department of Education (Terri Campbell), and a community science educator (Janet Blalock) attended the conference. Later, Jennifer Coggins, Peggy Cowan, Marjorie Menzie and Nanci Spear also joined the Alaska Global Change Education team.

Funding for a global change education planning grant was obtained, surveys were conducted and education materials were researched as to availability and suitability for use in Alaska. Among the materials and programs reviewed and chosen, was the GLOBE (Global Learning and Observations to Benefit the Environment) Program.

The GLOBE Program is an international hands–on environmental science and education program that connects K–12 students, teachers and scientists around the world for research collaboration and cross–cultural enrichment. Alaska teachers and students are participating in the GLOBE Program which involves more than 7,000 schools in more than 80 countries. Alaska students are contributing to a "global" picture of the health of the earth as they monitor their local environment.

Understanding global changes in the atmosphere, hydrosphere, lithosphere and biosphere are vital in predicting causes, impacts, and potential responses to these occurrences. Most global change environmental issues relevant throughout the world, such as climate change, ozone depletion, increased ultraviolet radiation, and decreased biodiversity are also of local importance in our resource–rich state.

Global warming is expected to be of greater magnitude in high latitude areas such as Alaska. Data sets for Alaska and the Arctic indicate a warming trend of 2–4º C over the last 50–100 years. A warmer climate could cause the melting of permafrost, sea ice, snow, and glaciers, all prominent features of the Alaska environment. Permafrost underlies most of the state. Extensive sea ice occurs along Alaska's western and northern coasts. Snow covers the ground in Interior Alaska for six to seven

Photo by Nancy Johnson and Michelle Boyden

Globe students Jackie M., Devona C., Leianna H. and Rosie L. work as a team checking their plot every day during spring and fall.

months out of the year. Climate warming is believed to be the main cause of rising sea level. The melting of mountain glaciers along the Gulf of Alaska has apparently been a major contributor to the observed global sea level rise. These conditions could impact the environment, including the habitats of plants, fish, and animals. Climate changes could impact not only ecosystems, but also the subsistence life–style of Alaska's indigenous people.

Photo by Michelle Boyden and Nancy Johnson

Globe students Amanda D. and Allison P. making ground observations to help validate remote sensed images.

Alaskans need to be well educated on these high priority global change environmental issues in order to make well–informed choices, prepare for consequences of global environmental alterations, and take mitigating steps. Alaskans, as well as people from other places, need to realize that we are affected by what happens worldwide, and that what happens locally and regionally, in turn, has global implications.

The Alaska Global Change Education Team, with Elena Sparrow as the principal investigator and instructor of the course, successfully obtained a grant from the US Environmental Protection Agency to teach a course titled Earth System/ Global Environmental Changes for K–12 Educators. The course was distance–delivered to three sites in Alaska: Anchorage, Fairbanks, and Juneau. Teachers learned about earth system changes such as climate change, enhanced greenhouse effect, sea level rise, and ecosystem response. AFES faculty members Glenn Juday and Dave Valentine were also scientist presenters for the course.

Photo by Nancy Johnson and Michelle Boyden

Color charts to track the color changes in the leaves in their GLOBE study plots are used by students.

The Alaska GLOBE Franchise initiated by Elena Sparrow was established through the Center for Global Change and Arctic System Research. The GLOBE Franchise is an agreement between the GLOBE Program and UAF which will work cooperatively within the University of Alaska Statewide System to undertake responsibility for recruiting GLOBE Schools, training GLOBE teachers, and mentoring GLOBE students throughout Alaska.

Scientists around the world use GLOBE data in environmental research. Teachers receive special training and educational materials for implementing the GLOBE program. Students under the guidance of GLOBE–trained teachers make a core set of environmental measurements at or near their schools, send their data via the Internet to a GLOBE data processing center, receive and use global images created from GLOBE data and other science sources, and study environmental topics in their classrooms. GLOBE students are able to communicate and collaborate with other students in the U.S. or the world, who like them are generating new knowledge about our planet Earth. The GLOBE website is http://www.globe.gov.

Seasons: The Global Plant Waves

Two AFES faculty members, Dave Verbyla and Elena Sparrow, and Leslie Gordon, an education specialist from the Fairbanks North Star Borough School District are co–principal investigators of the *Seasons: The Global Plant Waves* project which started in May 1998. Check out our home page at http://www.lter.uaf.edu/~dverbyla/globe.

Every year there are important waves occurring that you can see from a global perspective— the wave of green–up as conditions for photosynthesis improve and the wave of green–down or senescence as plants become dormant. These waves are important because they are directly related to global carbon fixation. With global warming and changes such as El Nino, these waves are expected to change significantly. These global changes have already been detected! For example, the spring green–up has advanced by eight plus/minus three days since the early 1980s at high latitudes.

The greenness index measures reflectance related to photosynthesis and plant cellular structure. The index is derived from satellite data. Each satellite sensor is calibrated for spectral reflectance before being launched, however this calibration drifts as the satellite sensor ages and therefore estimates become less accurate. Also since the sun angle changes with the seasons and the viewing angle of the sensor changes with image location, estimates can have low precision. Thus, on–the–ground observations of spring green–up and fall senescence are needed to validate estimates of growing season that are possible using satellite data. The GLOBE program is probably the best opportunity scientists using remote sensing of the globe have at obtaining on–the–ground observations of plant leaf phenology.

The goal of the project is to improve math, science, and technology in K–12 classrooms by providing an opportunity for scientists and students to collaborate on a research project of real significance to scientists who are tracking plant phenological changes as an indicator of global change. Both students and scientists will benefit from participation in this project. Students will take part in an authentic science project where they have the opportunity to apply what they are learning to create new knowledge.

Students are involved in school site observations and recording of plant green–up and senescence at their GLOBE study sites. Students will also study the climatic variables affecting plant growth in their location. Four Fairbanks schools piloted the green–up protocols in the spring of 1998 and fourteen K–12 schools from Alaska piloted the senescence protocols in the fall of 1998.

To learn more about this program contact Elena Sparrow, e–mail ffebs@uaf.edu. GLOBE teacher training workshops are held yearly.

Bonanza Creek Schoolyard LTER

by John Irons, LTER/School District Liaison

The Bonanza Creek Schoolyard LTER is part of the Bonanza Creek/Caribou–Poker Creeks Long Term Ecological Research (LTER) program, funded by the National Science Foundation. A co–operative program to provide interaction between LTER scientists and the Fairbanks North Star Borough School District (FNSBSD) teachers and students is being explored to determine the feasibility and desirability of integrating LTER sites with local schools and the GLOBE program.

We want to provide unique learning experiences both inside and outside the classroom for K–12 students, training and support for FNSBSD science teachers at all grade levels, and collect datasets useful to the LTER that might otherwise be impossible to get.

The AFES faculty involved in this project include Dr. Elena Sparrow (Alaska Global Change Education Co–coordinator and Affiliate Associate Professor of Soil Microbiology and Science Education), Dr. Glenn Juday (Associate Professor of Plant Ecology), and Dr. Dave Verbyla (Associate Professor of Forest Sciences).

Visit our website at http://www.lter.alaska.edu/~jirons/schoolyard_lter/schoolyard.htm for more information on this project.

Distance Delivery: SALRM reaches out

by Dr. Carol E. Lewis, Professor of Resources Management
and Dr. G. Allen Mitchell, Jr., Interim Director, Agricultural and Forestry Experiment Station

World Wide Web, internet, multi–media conferencing, interac–tive, real–time networking. The future? No, these are tools for today's interactive classroom. All of these tools, and more, are available to deliver information to a world that demands new knowledge.

Distance delivery enhances the instructional quality and availability of natural resource management related courses to degree–seeking students and interested members of the public across the state of Alaska. It emphasizes the importance of curriculum diversity and statewide faculty and student interaction. Integrating off–campus students and faculty electronically into audio and video interactive courses taught both on and off the Fairbanks campus will enrich the classroom experience and curriculum and decrease the unit cost of instruction.

The computer has become a dynamic force in the field of education. In most areas of the United States, electronic infrastructure permits the use of many new and innovative teaching methods. The internet, multi–media conferencing, and interactive, real–time networking are all tools available to instructors and students. This is not the case for all sites in Alaska.

New–age electronic infrastructure has not been extended to regions where demand is low. The state of Alaska is one of these low–demand regions. University of Alaska statewide communications experts and faculty and staff of the School of Agriculture and Land Resources Management and the Agricultural and Forestry Experiment Station (SALRM/AFES), a part of the University of Alaska Fairbanks (UAF), are cooperating to deliver the Natural Resources Management bachelor of science degree program to electronically remote regions of Alaska. The target is students who cannot complete their degree in residence at the Fairbanks campus.

The Need for Distance Delivery

The future of higher education in Alaska will depend a great deal on how we effectively maximize the use of a limited faculty and fiscal resources to meet the diverse needs of geographically constrained, "place disadvantaged", potential and current students. Students throughout Alaska would like to have the opportunity to enroll in the Natural Resources Management B.S. degree program but they cannot spend four years on the Fairbanks campus. Employers are increasingly looking to us to provide potential employees who have completed the science–based management degree that is our hallmark.

Faculty who could offer courses of interest to current and potential students interested in Natural Resources Management, are dispersed geographically from Juneau to Anchorage to Palmer and other more rural areas of the state. Low enrollment or in some cases no course offerings makes it difficult to meet the needs of students. Faculty who are not located on the Fairbanks campus often have unique skills that are not used as cost–effectively or as extensively as they could be.

The Challenges of Distance Delivery

In an archaic world, distance delivery consists of an instructor traveling, often long distances, to the classroom. At its dynamic best, audio linking is used. In the latter case, the interaction of students and instructors is limited to voice only unless the fax and videotape are included in delivery options.

Anchorage, Fairbanks, and Juneau are currently the only sites that can access a suite of technological tools associated with computer networking and real–time delivery. However, when user numbers are low, transmission costs are high. This means that instructors, support staff and students must be innovative and willing to work with less sophisticated tools. The challenge is to bring high–quality interactive support into the classroom and doing more with less.

SALRM/AFES faculty began to distance deliver courses using 'audiographic' technology with a software package referred to as Telegraphics. This technology was first introduced at the University of Alaska in 1990. While not as sophisticated or interactive as real–time, the technology combines computers, telephones, modems, document scanners, and video cameras for still pictoramas to bring students and instructors together in an active environment conducive for discussion. The technology very closely simulates a classroom, but in still–life format.

Software is now available that incorporates a networking feature with limited–screen, real–time capability and can be used in combination with the internet. SALRM/AFES began using this software for the first time in the spring semester, 1999. While still not totally real–time interactive, the technology is a low–cost option and can be used to deliver information to those sites that have a limited electronic infrastructure.

The SALRM/AFES faculty and students face challenges similar to those encountered by all who use a computer–based technology in the distance delivery classroom;

- *Development costs are high.*
- *Technology can be distracting and threatening.*
- *Rapid growth in technology means constant change.*

Despite these challenges, we have entered the distance delivery classroom and are making it work.

What We have Accomplished

The Plant, Animal and Soil Science option in the Natural Resources Management B.S. degree program has been offered in the Matanuska/Susitna and Anchorage area (the Anchorage bowl) since 1995. Course offerings are centered at the Palmer Research Center, a part of the SALRM/AFES. When possible, courses are taught by faculty stationed at Palmer. Courses offered by the University of Alaska Anchorage are also used in the curriculum.

Despite the opportunities offered by Palmer faculty and the University of Alaska Anchorage campus, there were still gaps to fill. Using a combination of Palmer faculty and UAF faculty, we filled the gaps. To date, two students have graduated with the B.S. in Natural Resources Management, completing all of their requirements from their home base in the Anchorage bowl. There are 15 students enrolled in the program. This would not have been possible without the electronic technology we used to distance deliver our courses.

During the early years, faculty commuted. In 1996, we offered our first course using Telegraphics. This first class was also able to reach out to Ft. Yukon. Subsequent courses followed using a combination of Telegraphics, e–mail, and minimal commuting.

In the 1999 spring semester, we upgraded to a network software system. Some say that the improvement is slight and others suggest we have gone a step backwards. However, we are using the computer classroom at the Matanuska/Susitna branch of the University of Alaska Anchorage that is equipped to deliver real–time interactive networking.

We have upgraded facilities and software and now faculty and students will be learning a new system. Staff with the University of Alaska Statewide Office of Information and Network Services continue to look for new software that is compatible with the clientele and locations we serve. We look forward to expanding our degree offering beyond the Anchorage bowl and as software and electronic infrastructure continues to improve this becomes more and more feasible.

Acknowledgments

Staff, faculty, and students helped make the distance delivery technology for SALRM/AFES work. Special thanks go to those who continue to support our efforts.

Without the help of the University of Alaska Statewide Office of Information and Network Services, the distance delivery program used by SALRM/AFES would not have been possible. Earl Vorhees, Network Communications Specialist, provides help above and beyond the call of duty and has done so from the start of the program in 1995. David Leone, former Manager of Customer Service made it possible. Steve Smith, Chief Information Office, and Bill Gregory, Manager, Technical Support, continue to help us update our technology and involve us with University of Alaska efforts to bring high quality education to remote areas.

Our students have tolerated our learning curve and mistakes. Two students received their B.S. degree because we were able to distance deliver courses. Thanks to Dan Hall and Cheryl Wickstrom for staying with the program. They have given incentive for others to follow in their path.

Faculty members are often reluctant to embrace new technologies, particularly when they are not easy to use. Thank you to those who are participating now and have participated in the past. Particular thanks go to Joshua Greenberg, Associate Professor of Resources Management who made the first course possible.

Staff support is essential when courses are delivered electronically. Peg Banks, former Personnel Coordinator provided that support at the Palmer Research Center. She helped set up our system and was there for us at every class. Thank you Peg from all of us. Elizabeth Lambert, Coordinator, is carrying on in Ms. Banks' place and we welcome her to the team.

The Natural Resources Management B.S. degree program originates from the Fairbanks campus. Working over distances, tirelessly, Barbara Pierson, Coordinator, recruited students, helped them register, and provided much needed moral support. The authors, University of Alaska support staff, and Ms. Pierson worked as a team to develop the appropriate technology and the format for our distance delivery courses. Words are not enough.

It takes a team and will continue to take a team to bring the Natural Resources Management degree program to students and those interested in natural resources management who live in areas where information is easily accessible. It takes a special effort of a very dedicated team to bring natural resources management knowledge to areas not easily reached by "conventional" technology. Thank you to all the members of that dedicated team.

Reindeer for Education and Research

by Todd Nichols, Research Technician

Many people in Alaska, even some long–time residents, are unaware that there are approximately 30,000 (mostly free–ranging) reindeer in the state. This spring we began visiting elementary schools in the Fairbanks North Star Borough School District with a reindeer in tow to share information about reindeer. Our visits focus on teaching the students about adaptations of reindeer to the arctic, compariing what caribou and reindeer really are, while avoiding the whole topic of Santa and his mythical reindeer. We give 30 minute presentations including a question/answer session followed by an up–close visit with the reindeer so that characteristics discussed in the class can be observed. All kids get to pet the deer and some have an opportunity to give her a nibble of lichen. These presentations serve as a supplement to the units on Alaska (arctic) animals being taught in the school curriculum. Our reindeer now all have names selected from a pool of names given by the kids.

This program will be expanded to additional schools and grade levels in coming years. In Nome and villages on the Seward Peninsula these presentations are supplemented with Eskimo translations.

Impromptu information is given at the Fairbanks Farm on all aspects of the reindeer. As a result, reindeer management and research may become the juncture for increased interest in both agriculture and wildlife (i.e. range management).

Established in 1981 in a cooperative study with the Institute of Arctic Biology (IAB) the Reindeer Research Program is now managed as a long–term project within the Agriculture and Forestry Experiment Station (AFES). This project has been responsible for developing a vaccine for Brucellosis, a bacteria found in many Bovids, Cervids and other mammals including humans, and a major concern in ranching. Currently, our deer are maintained at the AFES farm and IAB manages their reindeer, caribou and muskox mainly at the Large Animal Research Station (LARS). Their research focuses primarily on physiology and behavior. Our research is more applied and directed toward enhancing management of free–ranging herds and to some extent captive herds along the road system.

Research

In the summer of 1997 we shipped twenty female reindeer calves from Nome to the AFES Fairbanks Farm. Research with these deer primarily involves small–scale testing of alternative management techniques and equipment for free–ranging herds in Western Alaska, and developing an economical feed formulated with mostly locally grown constituents. Feeding trials provide information we can use to decide if range condition directly correlates to reindeer condition and productivity.

Corralling and handling herds of reindeer on the Seward Peninsula occurs annually during late January and from the end of May to early July. Activity associated with handling hundreds to more than two thousand reindeer during a corralling can be hectic and the conditions frequently are unpleasant. Record keeping, collecting tissue samples and productivity data, administering vaccinations and

Reindeer Research Program photo

Greg Finstad gives a student an opportunity to feed lichen to Elsa. Elsa is handled and trained by Natalie Howard.

Reindeer Research Program photo

Todd Nichols is breaking Summit to halter. Before taking the deer to schools, they must be halter broken and worked with to overcome their natural shyness of people.

conducting various other projects work best if well–planned for greatest efficiency. It is best for both reindeer and people alike if delays are reduced to decrease handling time. We test the use of equipment and practice techniques at the farm prior to arriving in a remote setting where proper functioning is required. For instance, we test the use of electronically–scanned identification implants in our reindeer at temperatures to minus 30º F. We also need to know the capabilities of insulating holsters used for automatic steel syringes with viscous vaccines at these low temperatures.

Feeding Obstacle

Developing a commercial diet that uses locally grown grains and forages has the potential to benefit both free–ranging and captive reindeer. However, captive situations are complicated by the cost of commercial feeds relative to profitable growth rates. Reindeer do not produce enough lean muscle mass to compensate for feed cost. It is the low or negative winter growth rate that makes raising reindeer in captivity so economically risky.

In a free–ranging system supplemental feeding may at best facilitate survival through winter. It is understandable that free–ranging reindeer undergo a reduction in their growth rate and lose weight during winter in response to decreasing food intake. However, concluding that this growth cycle is a passive result of declining seasonal resources may be false.

The decline in growth may be an adaptation to a challenging environment. The cause and effect underlying the pattern of growth observed in reindeer is blurred. For instance, the decrease in growth may not be a direct proportionate response to decreasing quality and quantity of forage, but rather an intrinsic decline in metabolism initiated by seasonal cues regardless of food availability. This has been observed in sheep and whitetail deer. It seems that in the winter, even when given unlimited feed, reindeer reduce their food intake to lower their metabolism before showing a decline in growth and subsequent loss of weight mediated by a fasting metabolic rate. The lower metabolism in turn lowers energy requirements, helping maintain a balance between nutritional demands and resource availability. This voluntary decline of food intake, along with metabolism, digestion and growth adaptations in reindeer/caribou, may not necessarily be unique arctic adaptations— just the same functions found in temperate Cervids operating at the extreme.

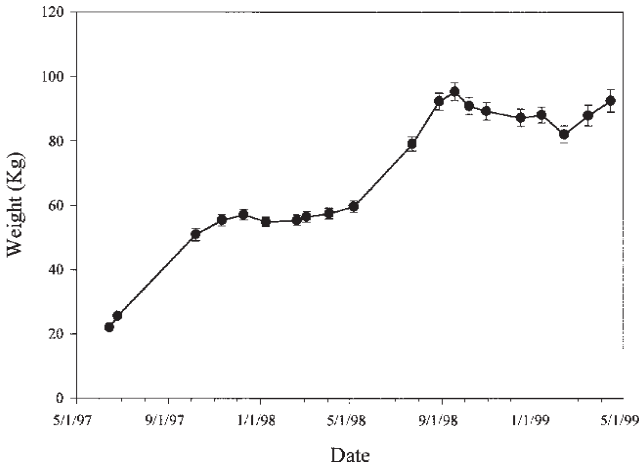
Declining growth rates going into winter may be suppressed with unlimited feed availability of natural forage and/or commercial feed. In some instances, calves taken from the range in autumn and weaned onto a concentrate feed may show a slight continuation in their growth going into the winter. However, the intrinsic decline in growth rate, and sometimes a slight loss in weight, appears largely unaffected by a consistent supply of high quality balanced feed. Our feeding trials, which vary the amounts of forage, minerals, protein and protein sources, have resulted in no significant differences among groups so far. Figure 1 shows the decreasing growth rate and minor weight loss during two winters. These observations correspond to known growth patterns.

Whether or how our feed affected these changes in growth is uncertain. However, a critical point in

Reindeer Research Program photo

Todd Nichols with the help of Alex Prichard, Rhonda Wadeson, and Natalie Howard are doing the spring weigh–in for the reindeer. Spring weights show an increasing growth rate as shown in Figure 1.

Figure 1. Growth rate has been shown to change with the seasons. It declines going into the winter and sometimes the dear even lose weight.



reference to feeding reindeer forage like hay and alfalfa is that reindeer will not or cannot consume all parts of hay. Even starving reindeer have been observed declining the "rougher" chaff particles. Our deer corroborated this feeding behavior during our forage trials. The amount of hay and alfalfa that was refused was proportional to the amount formulated into the diets.

The yearlings show the beginning of a decline in growth rate more than one month earlier than when they were calves (Fig.1). We don't know whether this timing has a consistent pattern. In autumn '98 in the middle of a trial comparing fishmeal and soybean meal as protein sources, the yearlings went from a high positive growth rate to a negative rate. The decline in growth rate began toward the end of August during rut. These cows were not bred. However, there are no substantial data indicating a hormone feedback as a result of consecutive estrus cycles and subsequent weight change in response to not being bred. It is difficult to directly compare data from other areas or management regimes. Scandinavia has more temperate seasons which may allow growth to extend through autumn. Other minor variations in weight, such as the slight increase in mid January '99, may be the result of food intake that usually cycles slightly every few days, especially when fresh feed is added to unconsumed food.

In the process of developing feed both external and internal factors, like photoperiod, bacteria:protozoa ratio, digestive tract mucosa, growth stimulating hormones, and urea cycling in reindeer requires research. When looking at changes in weight the difference between fat deposition and building lean muscle mass must be considered.

Thus far, economic constraints in captive regimes are still too great for profitable results. Supplemental feeding of free–ranging deer should be conducted only to increase survival rather than growth.

Range Condition and Forage Preference

We are conducting an ongoing project analyzing diet composition and nutrient dynamics of preferred forage species of reindeer on Seward Peninsula ranges. Our reindeer at the farm may provide a reference for correlating nutrient flux (primarily of nitrogen, carbon and some non–limiting minerals) with changing forage preference through the growing season. We are currently using the stable isotope signature $\delta^{15}N$ (a normalized ratio of the abundance of the rare ^{15}N to the more common ^{14}N) to relate antler production to consumption of forage groups. The $\delta^{15}N$ is modified by various microbial and plant processes within the nitrogen cycle. In plants, this ratio appears to be consistent within forage groups and may differ predictably enough among groups to detect changes in diet composition of the reindeer. We are establishing a database of $\delta^{15}N$ for preferred forage species as they change phenologically. The $\delta^{15}N$ signatures in antler may reflect differences in forage groups between ranges. The changes in diet composition represented by differences in the signatures among forages may be retained within the chronological layering of antler tissue through the growing season. To date, we show distinct differences among ranges in both forage and antler samples.

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Initial Forest Stand Density and Wood Quality: A preliminary report

by Edmond C. Packee, Ph.D.; CF, CPSSc,Associate Professor of Forest Management

In 1984, the Agricultural and Forestry Experiment Station (AFES) began studying the Growth and Yield of Alaska's Northern Forest.[1] Part of that program is a Levels–of–Growing–Stock (LOGS) study. A LOGS study addresses stand density regulation. The AFES study has two components: espacement, which refers to initial stocking and spacing, which refers to precommercial thinning. Both affect growth rates and tree characteristics. Individual tree characteristics impact wood quality. In 1998, a review of the international literature on the effects of espacement on wood quality, especially Alaska species, was initiated.[2] Emphases are on the impacts of espacement and spacing on per acre fiber yield and wood quality; initial stocking levels to obtain high volume per acre yields of quality fiber are suggested.

Alaska's forests belong to two major ecological units, the Coastal Forest and the Northern Forest. The two are dissimilar in environment and species composition; however, managers share a major concern—the cost of regeneration following harvest or loss of a stand due to a catastrophic event. Espacement, the number of trees per acre planted or naturally occurring, affects rate of diameter growth and other stem characteristics. Spacing, the removal of excess small stems, has similar affects. "Whatever is done to modify the growth rate may also modify the properties of the wood that is formed."[3]

Wood properties affect wood quality and thus end use. To maximize forest fiber value, resource managers and foresters need to understand not only the principles of tree growth, but, also, some of the features that determine wood quality.[4] Although there is a rich literature base addressing wood quality and the impacts of early stand treatments, much is not readily available to the practicing forester nor is it necessarily specific to Alaska species.

The forest owner or manager determines the management objectives for a piece of property or a stand. Two basic approaches exist in terms of the future yield from the land: 1) fast growth with reduced fiber quality and volume per acre, or 2) slower growth with higher fiber quality and greater merchantable volume per acre. Obviously, there can be a compromise for a forest property, but the objectives must be known prior to the regeneration effort.

Wood Quality and Initial Stand Regulation

Wood quality is a concept. "Most simply, wood quality is the suitability of wood for a particular end use."[4] It is "a measure of the aptness of wood for a given use."[5] Thus, it is "a measure of the characteristics that influence properties of the products made from it."[3] Wood quality is the arbitrary classification of variations in the type, size, number, shape, physical structure, and chemical properties of a piece of wood, the size of which may range from individual fibers and cells to the entire tree. Wood characteristics vary by species; hence, wood quality is a combination of species' characteristics and end uses. Certain species are suitable for certain end uses and not for other end uses. Hence, the definition of wood quality varies and must incorporate end use. Actual properties of wood that make it useful for a particular product depend primarily on specific gravity, fiber length, cell–wall thickness, and cellulose and lignin content.[6]

Brazier[7] summarized the influence of tree crop spacing on wood characteristics:

Close Spacing	Characteristic	Wide Spacing
Smaller	Girth	Larger
Lesser	Taper	Greater
Smaller	Knots	Larger
Higher	Wood Density	Lower
Narrower	Core Wood	Wider
Higher	Wood Substance Yield	Lower
Lower	Sawn Wood Yield	Higher

Major causes of degradation in young–growth lumber are knot size and frequency, reaction wood, core wood (juvenile wood), taper, spiral grain, and reduced specific gravity (wood density). Often these characteristics are interrelated (e.g., core wood of conifers commonly contains appreciable amounts of compression wood; core wood and compression wood are inseparable). These same wood characteristics also affect fiber quality for veneer, pulp, and paper. "Anything the silviculturist can do to minimize the effects of these factors will substantially increase value production from forest stands. Silviculturists can influence wood quality by treatments that affect spacing, live crown ratio, and growth rate, and also through tree breeding."[6]

Timmel is more specific:

"Regulation of stand density…is the most powerful method available to the forester for changing both yield and quality of wood. This density is determined by the initial spacing and by any subsequent thinning. The space available to a tree has a decisive influence on the properties of the wood produced. Widely spaced trees maintain a rapid rate of growth for a long time and develop a large crown favoring formation of low–density, juvenile wood, stem taper, large branches, and a slow natural pruning, all undesirable traits. A close spacing affords a larger total volume of wood, is less subject to certain harmful environmental effects, and offers a wider choice in later thinnings. Disadvantages are that a dense stand is more expensive to establish and requires a long time to reach exploitable size. Which initial spacing is chosen, is often an investment decision."[8]

Mechanical suitability is important in the construction industry; it is a major constraint for the use of Sitka spruce. Thus, wood density is important—low wood density results in reduced strength. Knots reduce the effective bearing section, but more importantly result in grain deviation and associated weakness. Core wood is also inherently weak. Preliminary data from espacements of 3, 3.5, 6, and 8 feet indicate "that the percentage of the battens [equivalent to 2 x 4's] reaching a given load increased as planting distance narrowed and there must be some concern that, at the widest spacing, a high proportion failed to reach an acceptable level of performance."[7] In Britain, using intensive silviculture, a thinning regime resulting in an increase in increment late in the rotation is suggested; an initial espacement of 6.0 feet or more is considered too wide with the probable optimum being 5.5 feet. However, common espacement in Scotland is 6.5 to 8.2 feet.[9] Although target plantation stocking for Sitka spruce in British Columbia is now about 10 feet (about 400 to 440 stems per acre), 27–year results of a LOGS study, suggest an espacement range of 11.7 to 8.8 feet (320 to 560 trees per acre).[9] The wider espacement levels produced trees with larger stem diameters, larger crowns, larger branches, and lower volumes per acre.

Branch size increases with increasing spacing for the spruces. This has been documented for white, Sitka, and Norway spruce. In Germany, branch diameter cannot "exceed 20 mm" (slightly more than three–quarters of an inch) if wood is to be used for lumber.[8] In France's Cantal region, spruce is planted at a spacing of 6.5 feet.[10]. In Denmark, leader (growing tip) damage to Norway spruce increased from 3 to over 30 percent when initial espacement increased from 4.1 feet to 10.7 feet; the increase was drastic beyond 5.75 feet[8]; such damage contributes significantly to compression wood production.

Fifty–year results for the Petawawa white spruce LOGS study near Chalk River, Ontario,[11] summarized in the attached yield table, demonstrate the impact of initial stocking on yield for five top heights (80, 70, 60, 50, and 40 feet). Top height is the average height of the tallest 40 trees per acre. Espacements were 4 x 4, 6 x 6, 8 x 8, and 10 x 10 feet (1 through 4, respectively). For each top height and espacement, the table provides the number of trees per acre surviving and mean diameter at breast height. Basal area, total volume, and merchantable volume per acre are stand characteristics. Individual tree diameter combined with stand characteristics provide economic parameters for harvest as well as habitat descriptors.

Based on the Petawawa data, maximum basal area (square feet of stem cross section) appears to level off at about 255–256 square feet per acre. Significant mortality only occurs for the 80–foot tall trees at the 10 x 10–foot spacing; for heights of 60 feet or less, no mortality occurs. This suggests that available growing space is not fully utilized. Mean diameters for the 8 x 8–foot espacements range from 0.3 to 0.9 inches less than for the 10 x 10 espacements. Total and merchantable volumes are greater in the closer espacements, e.g., from 201 to 296 cubic feet more for the 8 x 8 than for the 10 x 10–foot espacements. Apparently, wider espacements (≥14 x 14 feet) simply failed as plantations. This strongly supports an 8 x 8–foot espacement for white spruce.

Personal experience with western redcedar and Alaska–Cedar indicates that wide spacing results in reduced height growth and increased branch length, diameter growth, and stem taper. These two species do not exhibit strong apical dominance and tend to expand crown radial growth at the expense of height growth. This was observed for spacings of 10 x 10 feet and was less for 8 x 8 feet on northern and western Vancouver Island, British Columbia. Hence, espacement for these species should be less than 8 x 8 feet.

Core wood, commonly referred to as juvenile

Preliminary Espacement Guidelines for Alaska Species

Species	Stems/acre	Spacing in feet
Coastal		
Pacific Silver Fir	680	8 x 8
Subalpine Fir	>680	<8 x 8
Alaska–Cedar	>800	7 x 7
Sitka Spruce	680–435	8 x 8–10 x 10
Shore Pine	540–435	9 x 9–10 x 10
Western Redcedar	>800	7 x 7
Western Hemlock	680	8 x 8
Mountain Hemlock	680	8 x 8
Western Black Cottonwood (if thinning is planned)	435?	10 x 10?
Northern Forest		
Tamarack	680	8 x 8
White Spruce	680	8 x 8
Black Spruce	800–680	7 x 7–8 x 8
Paper Birch	435	10 x 10
Balsam Poplar	300	12 x 12
Quaking Aspen	540	9 x 9

wood, is under strong genetic and species control. It typically forms near the pith of the tree and can include the first 15 to 20 years of radial growth regardless of height position in the tree. Close espacement reduces the amount of core wood produced because of the effect on radial growth—a smaller core means a smaller percentage of core wood in a piece of wood of the same diameter compared to a piece that was grown more rapidly. Reduced radial growth due to espacement is documented in the Petawawa yield table.

Preliminary Espacement Guidelines for Alaska

These guidelines are based on the literature, interpretation of guidelines from other regions, guidelines for similar species, information from various private entities, and personal observations across North America. Several colleagues in the private sector have indicated that their organizations have changed from being proponents of fast growth of individual trees to advocates of high volume per acre and associated higher quality wood fiber. Suggested espacements can be used, also, as stocking targets for survival at the free–to–grow stage of stand development or as early stand spacing targets. Tree geometry, tree height, crown diameter, and crown volume which define growing–space utilization, is largely the basis for the recommendations. To fully utilize the site requires crown occupation of available growing space. The guidelines are for single–species stands. Mixed stands, depending upon the species' shade tolerance, can have an average, lesser, or greater espacement.

Encouragement of side–shading to cause natural pruning of branches, at least on the butt log (12 to 16 feet), is also desirable. Pruning of the best 200 to 300 crop trees per acre may be an attractive investment alternative to spacing or thinning or may be used in combination with spacing. Pruning desirability is species dependent as well as market dependent.

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Yield of Unmanaged White Spruce Plantations near Chalk River, Ontario[11]

ROTATION AGE TOP HEIGHT = 80 FEET

	INITIAL ESPACEMENT TREES NO.	DIST. FT.	TREES PER ACRE (no.)	MEAN D.B.H. (in.)	BASAL AREA ($ft.^2$/acre)	TOTAL VOLUME ($ft.^3$/acre)	MERCH. VOLUME ($ft.^3$/acre)
1	2722	4 x 4	620	8.7	255	7331	6598
2	1210	6 x 6	500	9.2	229	6817	6135
3	681	8 x 8	430	9.5	211	6481	5833
4	436	10 x 10	370	9.8	193	6152	5537

ROTATION AGE TOP HEIGHT = 70 FEET

	INITIAL ESPACEMENT TREES NO.	DIST. FT.	TREES PER ACRE (no.)	MEAN D.B.H. (in.)	BASAL AREA ($ft.^2$/acre)	TOTAL VOLUME ($ft.^3$/acre)	MERCH. VOLUME ($ft.^3$/acre)
1	2722	4 x 4	890	7.3	256	6312	5618
2	1210	6 x 6	640	8.0	224	5644	5080
3	681	8 x 8	510	8.5	202	5229	4706
4	436	10 x 10	410	9.0	182	4927	4434

ROTATION AGE TOP HEIGHT = 60 FEET

	INITIAL ESPACEMENT TREES NO.	DIST. FT.	TREES PER ACRE (no.)	MEAN D.B.H. (in.)	BASAL AREA ($ft.^2$/acre)	TOTAL VOLUME ($ft.^3$/acre)	MERCH. VOLUME ($ft.^3$/acre)
1	2722	4 x 4	1245	5.9	238	5166	4494
2	1210	6 x 6	805	6.8	203	4454	3964
3	681	8 x 8	590	7.5	181	4006	3605
4	436	10 x 10	436	8.2	159	3610	3249

ROTATION AGE TOP HEIGHT = 50 FEET

	INITIAL ESPACEMENT TREES NO.	DIST. FT.	TREES PER ACRE (no.)	MEAN D.B.H. (in.)	BASAL AREA ($ft.^2$/acre)	TOTAL VOLUME ($ft.^3$/acre)	MERCH. VOLUME ($ft.^3$/acre)
1	2722	4 x 4	1680	4.8	208	3942	3272
2	1210	6 x 6	980	5.7	172	3273	2880
3	681	8 x 8	650	6.5	149	2840	2556
4	436	10 x 10	436	7.4	128	2470	2223

ROTATION AGE TOP HEIGHT = 40 FEET (approximate values, developed through interpolation)

	INITIAL ESPACEMENT TREES NO.	DIST. FT.	TREES PER ACRE (no.)	MEAN D.B.H. (in.)	BASAL AREA ($ft.^2$/acre)	TOTAL VOLUME ($ft.^3$/acre)	MERCH. VOLUME ($ft.^3$/acre)
1	2722	4 x 4	2104	3.9	172	2760	2210
2	1210	6 x 6	1115	4.6	136	2306	1885
3	681	8 x 8	681	5.5	116	1884	1640
4	436	10 x 10	436	6.4	100	1613	1439

Arctic Tundra Recovery from Crude Oil after 24 Years, Prudhoe Bay

by Dr. Jay D. McKendrick, Professor Emeritus

When oil spills occur, usually much commotion ensues as agency and industry personnel converge to stop the flow, contain it, and recover and/or remove the oil. If the spill is large, in prominent locations or special habitats, it usually receives proportionately greater attention from the public and media organizations. In time, these incidents lose their attraction and fade from headlines, until another occurs, and the process is repeated. Seldom are facts of long–term effects known, and as a consequence only the initial sensational aspects are reported, leaving the general public with the impression all spills are environmental disasters, with no hope for recovery. Nowhere is this incorrect impression more apt to persist than when crude oil is spilled on arctic tundra. Oil–blackened vegetation and terrain are the typical images associated with a tundra oil spill. The pervasiveness of that impression has a major influence as the public and agencies review environmental assessments for proposed production sites in Alaska.

Those overseeing oil spill control and mitigation must consider the long–term consequences of their decisions. It would be helpful for them to know the vegetation recovery potential in relation to the amount of oil spilled, which treatments are most effective, and when enough cleanup effort has been expended to assure vegetation recovery. The following data and accounts from some of our long–term observations of crude oil–treatment plots and an actual spill at Prudhoe Bay are given with those questions in mind.

Background

Before North America's giant oil field at Prudhoe Bay went into production and the Trans–Alaska Oil Pipeline was constructed, Alyeska Pipeline Service Company contracted with what was then known as the Institute of Agricultural Sciences (now the Agricultural & Forestry Experiment Station) to conduct oil spill revegetation research tests. Included in that three–year project was an experiment testing a gradation of Prudhoe Bay crude oil applied to wet tundra vegetation. The objective was to impose a range of oil spill intensities that we believed might span conditions should a real crude oil spill occur, and to evaluate the sensitivity of various tundra plant species to crude oil damage. In 1973 we had to estimate what the oil impact quantities might be, based on one accidental spill in the Prudhoe Bay region. Table 1 contains the calculated average amounts of oil in the three largest crude oil spills affecting tundra in the Prudhoe Bay and Kuparuk oil fields (through 1997). These ranged between about 420 and 915 barrels per acre (bbl/a), and our tests ranged from 64 to 1,000 bbl/a (Table 2). Thus, the experimental treatments simulated actual spill quantities.

Our gradient test was applied on 8 August 1973 without any cleanup or remediation. The plots lay half-forgotten until 1996, nearly a quarter century later. By relocating remnants of our gradient test plot corner stakes and referring to documentation in our contract report (Mitchell and McKendrick, 1975), we were able to identify the original treatments. On 20 and 29 August 1997, the vegetation was re-evaluated and photographed. The results are presented hereafter, as well as pertinent observations of a small burn test (1973) and fertilizer applications to an actual spill (1972) in the Prudhoe Bay Oil Field.

Methods

Gradient test plots (1973)

The experiment consisted of two replications with each containing seven 1–m^2 plots. Each replication included two untreated controls and five that were given oil applications. The oil applied represented the following spill quantities (thickness of oil in centimeters): 0.25, 0.5, 1.0, 2.0, and 4.0. Table 2 contains equivalent units of measure defining these

Table 1. Parameters for three major crude oil spills on tundra in the Kuparuk and Prudhoe Bay oil fields through 1997. Data provided by Chris Brown of ARCO Alaska, Inc.

Name	Year	Quantity (bbl)	Area Impacted (acres)	Estimated % Water	% Oil	Maximum oil (bbl/a)
2U	1989	300–600	1.43	N/A	N/A	419
2Z–2C	1993	100–170	0.1	46	54	918
1Y–1R	1994	250–500	0.23	70	30	652

Table 2. Plant species, mean canopy cover percentages, and active layer thaw depths measured on 29 August 1997 for six Prudhoe Bay crude oil treatments applied to wet sedge meadow tundra on 8 August 1973.

	Oil Applications (thickness (cm), barrel/acre) & gallons/a					
Thickness (cm)	0	0.25	0.5	1.0	2.0	4.0
Volume (barrel/acre)	0	63.6	127.3	254.5	509	1018
Volume (gallon/acre)	0	2,670	5,350	10,690	21,380	42,760
Species	• indicates species presence on 29 August 1997					
	Graminoids (grasses & sedges)					
Arctagrostis latifolia	•	•	•		•	
Carex aquatilis	•	•	•	•	•	•
Carex bigelowii	•	•	•	•	•	•
Eriophorum angustifolium	•	•	•	•	•	•
Eriophorum vaginatum	•	•				
	Forbs (broad–leaved herbs)					
Pedicularis sudetica	•					
Saxifraga hirculus	•	•				
	Shrubs & Half–Shrubs					
Dryas integrifolia	•	•	•			
Salix arctica	•	•	•	•	•	
Salix lanata ssp. *richardsonii*	•	•		•	•	
Salix reticulata	•	•	•	•	•	•
Total vascular species present	11	10	7	6	7	4
Mosses	•	•	•	•	•	•
Vascular Species Canopy Cover %	91	86	83	66	53	12
Active Layer Thaw Depths (cm)	47.1	49.7	44.4	50.0	53.2	45.5

applications in terms of barrels and gallons per acre. Plots were located in the central portion of a relatively flat polygon basin. That habitat was chosen because it represented the prominent habitat in the oil field, provided a uniform site sufficient in area for our plots, and owing to its relative flatness, oil applications could be easily confined to the plot areas.

Vegetation in each plot was inventoried before crude oil was applied. On 8 August 1973, measured quantities of warm Prudhoe Bay crude oil were poured over the plots as evenly as possible, using an ordinary sprinkler can to simulate oil spilling or spraying from a broken pipeline. Our objective was to identify the critical concentration below which cleanup and revegetation was not needed for tundra plants to recover from a crude oil spill. Only the 1974 observations, representing slightly more than a year time lapse, were available for the final contract report (Mitchell and McKendrick, 1975). With such a short period for tundra plants to respond, the most valuable information on tundra recovery was entirely unavailable for inclusion in that document. After a lapse of 24 growing seasons, our 1997 evaluation provides more definitive information on tundra vegetation recovery from crude oil spills.

Polygon trough experimental burn (1973)

Near these gradient test plots, we also applied 4 cm of crude oil to a 1–m² area at the intersection of two polygon troughs. The oil was burned immediately (Mitchell and McKendrick, 1975) (Figure 1). This burned plot was re–photographed in 1974 and again in 1978 (Figure 2). In 1997, we were unable to photograph the plot because vegetation cover was identical on all three possible polygon trough intersections in the vicinity. It will be necessary to probe the soil for the unburned stubs of wooden plot markers, in order to locate and re–photograph this plot.

Fertilizer plots in accidental oil spill (1972)

In 1972, a topped–crude (22° API gravity), which had diesel and heating oil fractions removed, leaked from a return line near the ARCO Alaska, Inc. topping plant at Prudhoe Bay (McKendrick & Mitchell, 1978). Burning and straw for absorption were used to remove oil from the frozen soil. In a portion that had been burned we applied two levels of a nitrogen–phosphorus–potassium fertilizer mixture to six plots late in June 1972. These applications were 77–154–154 and 154–308–308 lbs/a of N,

Figure 1. Burning 4 cm of oil applied to a polygon trough, 8 August 1973. All photos in this article are by Jay McKendrick.

Figure 2. Area burned in Figure 1 as it appeared six years later on 1 September 1978.

P_2O_5, and K_2O. Repeat photography (McKendrick, 1976; Hart and Laycock, 1996) was used to record the changes in vegetation aspects over time. Vascular plant biomass was measured one year after oiling. Cover was measured after 25 years. Photos (Figures 3 and 4) show the plots at the time of the fertilizer application (1972) and 25 years later (1997).

Results

1974 Observations

These were our conclusions after slightly more than one growing season following the different oil applications. They are from our contract report (Mitchell & McKendrick, 1975).

Vegetation:

Gradient test plots (1973)

- *Carex* and *Eriophorum* (Sedges) and *Salix* (willow) were the only vascular plant species to persist in all treatments, maintaining 25% of their pre–treatment canopy cover in the 4 cm treatment plot. Sedges maintained 50% of their cover in the 2.5 and 0.5 cm treatment plots one year after oiling.
- *Polygonum viviparum* (alpine meadow bistort) also survived in one 0.5 cm treatment plot. We speculated that may have been because that plant was in a more favorable microhabitat, where oil drained away.
- The 0.25 cm application was barely sufficient to distribute oil over the entire plot area.
- *Eriophorum vaginatum* (tufted cottongrass), which is uncommon in this coastal tundra, was not represented in all plots, therefore did not receive a fair test. However, it was intolerant of oil in the 2 cm treatment plot.

Polygon trough experimental burn (1973)

A year after burning, all vegetation was dead within the burned area. We estimated the peat layer may have been degraded by as much as 4

Figure 3. View of fertilized plots established in an accidental oil spill site, Prudhoe Bay, Alaska on 30 June 1972.

Figure 4. View of the same fertilizer plots in the accidental spill area, shown in Figure 3, after 26 growing seasons taken on 9 September 1997. Stakes to the right mark other fertilizer plots established after the original size. Vegetation is most dense in fertilized plots.

cm, but was not removed by the fire. Thermokarst had not occurred, and we reserved judgement on whether or not it might develop later.

Fertilizer plots in accidental oil spill (1972)

Before the 1972 growing season had lapsed, the fertilizer applications were showing remarkable benefits to the vascular plants and mosses in those six plots. Vascular plant biomass in the fertilized plots was more than twice that of the unfertilized area the first and second years following the spill (Mitchell and McKendrick, 1975).

Soil:

• In a test of thaw depth (soil active layer thickness) on 30 August 1974, depths averaged 38.9 cm in unoiled tundra and 37.1 cm in plots oiled at 4 cm treatment (Mitchell and McKendrick, 1975).

• After 24 years, the number of vascular plant species present in these plots ranged from 11 in the control to four in the 4 cm treatment plot.

• Canopy cover ranged from 91% in the control to 12% in the 4 cm treatment plot.

• Three sedges, *Carex aquatilis* (water sedge), *Carex bigelowii* (bigelow sedge), and *Eriophorum angustifolium* (tall cottongrass) occurred in all treatments.

• One willow, *Salix reticulata* (net leaf willow) occurred in all treatments.

• Moss was present in all crude oil treatments, but only sparingly in the two heaviest applications.

• One grass species, *Arctagrostis latifolia* (arctic polargrass) was present in all treatments except the 1 cm and 4 cm applications.

• Two willows, *Salix arctica* (arctic willow) and *Salix lanata* ssp. *richardsonii* (lanate willow) were present in all treatments, except those given 0.5 and 4 cm of crude oil.

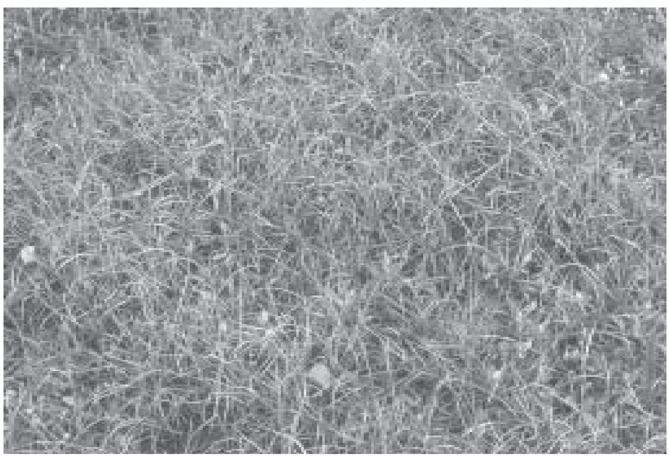

Figure 5. Control plot (no oil) in oil spill gradient test, Prudhoe Bay, Alaska on 20 August 1997.

Figure 6. Gradient test plot given 0.25 cm oil in 1973, Prudhoe Bay, Alaska on 20 August 1997.

• One half–shrub, *Dryas integrifolia* (mountain avens) was absent in plots given more than 0.5 cm of crude oil.

• One forb, *Saxifraga hirculus* (bog saxifrage) occurred only in the control and lightest oil application (0.25 cm) plots.

1997 Observations

These are our observations 24 growing seasons after the gradient test plots and the polygon trough was oiled and burned. The first fertilizer applications in the accidental spill site were 25 years old in 1997.

Vegetation:

Gradient test plots (1973)

• Indigenous tundra plant species were present in all treatments, and vigor of those was adequate for their survival and reproduction either vegetatively and/or sexually.

• Effects of oil applications were still visible after 24 years. However, without the contrast of an adjacent control plot, most observers would probably not discern the effects from the oil, except in the three heaviest applications. Recovery of tundra was most complete in plots receiving 1.0 cm (255 bbl/a) or less crude oil (Figures 5–10).

Polygon trough experimental burn (1973)

A photograph taken five years after the burning (Figure 2) revealed that no thermokarst had occurred at this location. Vegetation had not yet recovered from the oil and burning. However, by 1997, vegetation was completely recovered, making it impossible to re–photograph the plot without spending more time probing soil for stake remanents.

Fertilizer plots in accidental oil spill (1972)

Within two to three years, forbs, primarily *Saxifraga hirculus* and *Polygonum viviparum*

Figure 7. Gradient test plot given 0.5 cm oil in 1973, Prudhoe Bay, Alaska on 20 August 1997.

Figure 8. Gradient test plot given 1 cm oil in 1973, Prudhoe Bay, Alaska on 20 August 1997.

were reestablishing in these fertilizer plots. However, for many years, the surrounding vegetation consisted only of a sparse sedge stand that survived the oil and burning. No seedlings were observed establishing, and plant vigor was stunted, limiting growth and reproduction. No moss, shrub, nor lichen components survived the spill and clean up operations (Figure 3), and for a dozen years, that was the prevailing condition. Only during the past 10 years, have we noted substantial recovery in the unfertilized area of this spill. Fertilizer applied to other plots in 1985 (13 years later), resulted in an immediate response by the surviving sedges, which within five years recovered completely inside fertilized plots. Without fertilizer, significant, yet incomplete recovery required at least 20 years. Biomass production, vigor (height and leaf color), plant densities, and species composition distinctions between fertilized and unfertilized areas have persisted for at least 26 years (through 1998).

Soil:

- Soil thaw depths on 29 August 1997 ranged from 44.4 cm in the 0.5 cm treatment to 53.2 cm in the 2 cm treatment. Differences between the greatest and least thaw depths were significant, according to statistical tests, but these thaw depths were not well correlated with oil applications.

Discussion

Although oil spills receive much public attention and are of particular concern for wet tundra habitats in Alaska's North Slope oil fields, most spills have occurred on gravel pads, as opposed to impacting natural tundra vegetation. In 27 years of study in the region, we have observed only six crude oil spills on tundra vegetation. Just after oil began flowing through the Trans–Alaska Pipeline there was a spill in the foothills. In the oil fields, we are aware of three winter spills, two that occurred when topped crude flowed beneath snow from return lines after resuming use following a temporary suspension of a return line (the 1972 spill described here), and one leak at Drill Site 5 when a pipeline failure sprayed crude oil across the snow surface. Wind carried this spill at least a quarter mile across the tundra. This spill amounted to less than our lowest treatment in the gradient test. We know of two summer spills caused by leaks at pipe connections. The size of the areas impacted by oil ranged from approximately 200 ft^2 to less than two acres. Records show that even though a large number of spills are reported, most are refined products (McKendrick, et al., 1981). Few of these impacted tundra vegetation, because they occurred on gravel pads.

How Oil Damages Vegetation and Soils

Oil kills vegetation in a manner similar to contact herbicides. In fact, diesel oil was once used as an herbicide to selectively control weeds in carrots. Carrots are more tolerant of a light application of diesel than co–mingled weeds, indicating a variation in the sensitivity among plant species to hydrocarbons. The light fractions (short–chain) and aromatic (ring structure) hydrocarbons are most damaging to plants. These compounds penetrate and destroy cellular membranes, causing contacted tissues to die. If these tissues are vital to the plant's survival, the entire plant may die. If not, then the plant will survive, with only the affected tissues dying, i.e., the typical plant response to a contact herbicide. Long-chain fractions may coat the surface of leaves and stems, preventing normal gas exchange. If sufficient leaf and stem tissues are affected accordingly, the entire plant may die. If otherwise, the plant will regenerate normal new growth, even though the long-chain hydrocarbons may persist on portions of the plant.

Hydrocarbons damage soils by altering normal water relations, essentially creating a droughty or

Figure 9. Gradient test plot given 2 cm oil in 1973, Prudhoe Bay, Alaska on 20 August 1997.

Figure 10. Gradient test plot given 4 cm oil in 1973, Prudhoe Bay, Alaska on 20 August 1997.

hydrophobic habitat, until soil microbial populations degrade the oil. Limiting available water to plants definitely affects vegetation survival and development. The added organic carbon also imbalances the carbon:nutrient ratios in soil as microorganism populations increase to decompose the new carbon compounds. This deprives higher plants of nutrients; hence, there are often positive responses by mosses and vascular plants where fertilizer is applied to oil spills. Just such a response was observed following the 1972 application of fertilizer on the spill near the ARCO topping plant.

Season, weather, and soil properties are all factors that affect oil–spill impacts on vegetation. If the spilled crude oil is perched atop frozen or water-saturated soil, the light and aromatic fractions will have time to evaporate before entering the soil profile. This reduces the oil's impact on vegetation, particularly sedges and grasses, whose perennating buds lie below ground and often escape the most damaging components of the crude oil, in wet habitats. That has often been the situation with winter spills in the Alaska Arctic. Green leaves of sedges can be seen emerging from the soil in our 1972 photo, which was taken only 20 days following discovery of the spill (Figure 5). Shrub stems are protected by bark, and their perennating buds are elevated above the soil surface, allowing the vital cambium and some perennating buds to escape damages if oil flows across the soil surface and does not coat aerial plant parts. This was the situation for some reserve pit leaks in the National Petroleum Reserve in Alaska (NPR–A) (McKendrick, 1986). At those locations, fuel–contaminated water flowed in wet channels and polygon troughs beneath willow canopies, and the shrubs survived.

If only the long–chain asphalt portions of crude oil remain in soil, vegetation can re–invade more easily than where aromatic and short chain compounds persist. This is often noted as vegetation invades abandoned asphalt roads, even in cold climates, such as Alaska. In contrast, if the soil is easily penetrated by spilled hydrocarbons, as in dry habitats, the most damaging components of the oil do not evaporate, but become entrapped within the soil profile, where they kill roots and perennating buds. This results in far greater damage to vegetation in the short and long term than were the same amounts of oil spilled either on frozen or on water saturated soils. By their nature, dry habitats are more susceptible to oil spills than wet habitats. This was reported by Walker, et al., (1978). The tests with crude oil and the actual spill reported here all occurred on wet ground that was either frozen or thawed.

Habitat

At the time this experiment began, we had observed only one oil spill, the 1972 topping plant spill at Prudhoe Bay. There was little information available on responses of tundra plants to crude oil. Conventional wisdom indicated wet habitats should be of major concern. Those would seem to be the most difficult and likely the most prevalent in Alaska's North Slope oil fields. Thus, our objective was to install plots on what appeared to us as the most prominent and most susceptible habitat. The polygon basins were the largest blocks of relatively uniform habitat. Rims and troughs were common, but occurred in narrow strips, which complicated our plot design. Furthermore, it was more difficult to control oil applied to rims and troughs, because the oil would drain from the rims and flow along the troughs.

According to our 1974 evaluation of the trough spill followed by burning, the combination of oil and burning killed the vegetation, except for a corner where the oil drained from the edge of the trough. Burning did not degrade the peat layer, owing to the wetness of the trough. Temperature monitoring, using thermocouples, revealed that temperatures at the surface of a burn on wet peat briefly reached 175 ºC. The maximum temperature at the 4 cm depth in the peat layer was 27 EC (McKendrick and Mitchell, 1978), well below that fatal to most plants. Our photo records are incomplete, but clearly sometime between the fifth and 25th growing seasons, natural vegetation has reoccupied the burned plot in the polygon trough. After seeing that recovery, it is obvious that burning is an effective oil removal method, and tundra vegetation recovers well from it, especially in wet habitats.

From observing oil spills and their effects on vegetation, it is clear now that our experiment would have been more informative had we included more tests in polygon troughs. When actual spills occur, liquids migrate to and concentrate in depressions and troughs. Fortunately, for the tundra vegetation, these trough habitats are the wettest habitats, and wet habitats are least sensitive to crude oil.

Vegetation

We observed in our 1975 report that the gradient experiment had limitations because not all species occurred in all plots. We reiterate that caveat again. With respect to plant species sensitivities to crude oil, only *Arctagrostis latifolia*, *Eriophorum angustifolium*, *Carex aquatilis*, *Carex bigelowii, Salix arctica*, *Salix reticulata*, and *Dryas integrifolia* were adequately represented for a sensitivity evaluation. Unfortunately, the experiment was not evaluated during the intervening years to document which individuals actually persisted and which died and were replaced by new recruits, and when these changes occurred. We are confident that the mosses present in 1997 were largely from new recruits, at least in the highest three applications. Vegetation response in our fertilizer plots confirmed that moss recolonization began and vascular plant growth increased in the year fertilizer was applied. Fertilizer also encouraged forb seedling establishment in oil-damaged sites. It is likely that at least some, if not all, of the individuals of the following species had reestablished as seedlings in these plots: *C. aquatilis*, *C. bigelowii*, *D. integrifolia*, *S. arctica* and *S. reticulata*.

Soils

Thaw depths after 24 years were similar to those measured a year after the oil was applied. This indicated that as long as the peat layer remained intact, thermokarst was of little consequence. There was no indication that thermokarst had occurred in these plots. Thermokarst would not be anticipated in the centers of polygons, because vertical ice wedges, which result in deep thermokarst, do not occur beneath such surfaces. Everett (1978) reported that 0.5 cm of crude oil applied to wet tundra soil had no measurable effect on soil physical and chemical properties, after three years. In contrast, 1.2 cm oil increased seasonal thaw, organic carbon, and available phosphorus. It decreased water infiltration and available cations of calcium, magnesium, and potassium.

Conclusions

- Applying Prudhoe Bay crude oil to wet tundra, at concentrations up to about 1,000 bbl/a, and leaving it did not cause major thawing of the permafrost.
- Burning to remove oil and fertilizing to promote vegetation recovery did not promote thermokarst.
- In the gradient test, dominant sedges and willows were able to either survive or reestablish to a limited extent in the highest oil treatment during the 24–yr period of this experiment. In the fertilizer test, recoveries by graminoids, forbs, mosses, and shrubs were accelerated.
- Moss was able to recolonize in all levels of the gradient test, but only with limited success in the heaviest treatments. Moss also recovered most quickly and completely where fertilizer was applied.
- The half–shrub *D. integrifolia,* had not recolonized after 24 years in plots receiving more than 0.5 cm (ca. 128 bbl/a or 5,350 gallon/a) crude oil.
- Forbs, although not well represented in the gradient experiment, seemed to be harmed more than other vascular plants by the oil treatment. This susceptibility may be related to their growth form and limited protection of their stems.
- Vascular plant canopy cover declined with increasing levels of oil applications from 91% in control plots to 12% in the highest oil treatment.

The most significant findings from this study for tundra vegetation are that wet tundra dominated by sedges and willows can recover naturally from small (255 bbl/a or less) crude oil spills without any clean up occurring. This means that for that spill category, sites could be left to recover naturally without any cleanup, and not cause severe, permanent damage to the tundra vegetation. Examples for this may be very remote sites, where costs of moving equipment, etc. would be unreasonable, or where cleanup operations might be hazardous to humans or facilities. It also suggests that cleanup of large quantities of oil need not be extended to remove all trace of crude oil for tundra vegetation to reclaim the affected site. In wet habitats, spills as great as 1,000 bbl/a of crude oil showed encouraging recovery after 24 years without any treatments to remove the oil.

Burning is efficient and effective in removing oil, if undertaken immediately, before the oil soaks into the soil. Burning may kill all tundra vegetation, but complete recovery eventually occurs, and if burning removes significant amounts of the oil, it is likely vegetation recovery will be accelerated. Fertilizing is very effective in tundra vegetation recovery, promoting moss regeneration within a single growing season. Biomass production, sexual and vegetative reproduction, and overall vigor of surviving plants and new recruits are improved with fertilizing.

Recommendations

Observations of the gradient trial, the burning test, and the fertilizing applications provided an exceptional opportunity to document the recovery of certain arctic tundra plant species damaged by an array of crude oil applications, ranging from a light spray to saturation of the upper soil surface. Because the vegetation is still recovering in the gradient test plots, particularly in those given the highest applications, that experiment should be marked with steel rebar and preserved for future evaluations to confirm the eventual recovery of all vegetation in all treatments.

Gradient tests ought to be initiated in polygon troughs, because that habitat type is where most oil spills concentrate. How various cleanup and removal methods affect tundra plant recovery in that habitat could be included in such experiments.

Because dry habitats are most susceptible to oil damages, it would be instructive to conduct burning, fertilizing and long–term recovery evaluations in those habitats.

Spill records show refined hydrocarbons have been spilled more often than crude oil in Alaska's Arctic. Little information is available regarding effects from those products on tundra vegetation and effectiveness of treatments to remediate such damages. Information on those topics would also seem useful.

Acknowledgments

Dr. Wm. W. Mitchell was responsible for obtaining the original contract, involving me with the project, helping establish field plots, writing reports, reviewing the first draft of this article, and reminding me of our gradient test plots.

Funding for establishing the gradient plots was provided by Alyeska Pipeline Service Company. ARCO Alaska, Inc. provided the crude oil. BP Exploration (Alaska), Inc. (now BP Amoco) supplied logistical support. The state of Alaska, through appropriations to Agricultural & Forestry Experiment Station, University of Alaska Fairbanks and the U.S. Department of Agriculture Cooperative Research, Education, and Extension Service formula funding provided salary support. Individuals assisting with plot installation included: Milton A. Barzee (deceased), Allen K. Mansfield, G. Allen Mitchell, Jr., Keith Poppert, and Peter C. Scorup. Frank Fisher, formerly with Alyeska Pipeline Service Company was instrumental in initiating the original contract for oil spill revegetation research. Chris Brown of ARCO Alaska, Inc. provided data for crude oil spills. I express gratitude to all who have assisted us with these activities.

I believe the information derived from this study can provide guidance in managing oil spills. Hopefully, this information should elevate confidence of the public, government agencies, and the oil industry that tundra vegetation can and does recover from such accidents.

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Wildlife and Vegetation Find Habitat Niches on Oil Field Gravel Pad

by Dr. Jay D. McKendrick, Professor Emeritus

Reasons for revegetating disturbances associated with resource development in Alaska's arctic oil fields are: 1) to control soil erosion, 2) restore wildlife habitat, and 3) improve aesthetics. With respect to gravel fill, only the last two reasons usually apply. Erosion of gravel fill occurs only when it is placed in either active stream channels, where floods remove entire sections in single catastrophic events, or in large lakes where wind–driven currents gradually eat away at margins of the fill. Establishing vegetation on the gravel would not be particularly helpful in either of those instances. Opponents of resource development in the arctic argue that any disturbance of habitat threatens the wildlife of the region. Gravel fill is one basis of objection. In my opinion, their argument against resource development in the arctic would have greater merit if it were openly directed to resisting on the basis that it alters wildland aesthetics. Unmolested wildlife find useful niches on disturbed sites, even on revegetated gravel fill. Furthermore, some wildlife species have been reported to actually prefer disturbed sites over adjacent undisturbed terrain (Troy, 1991; Truett, et al., 1994). With judicious rehabilitation, even the degradation of aesthetics can be overcome. I base my opinion on years of observing disturbances associated with oil exploration and production and the concomitant use of these sites by wildlife and vegetation as indigenous animal and plant species reoccupy disturbed ground all across Alaska's North Slope.

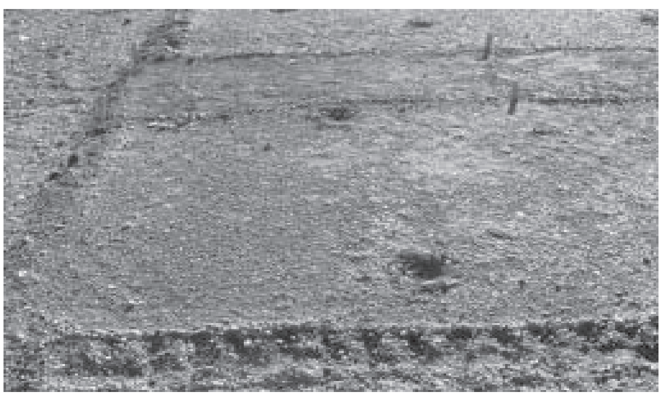

Figure 1. Barren gravel plots at the beginning of the long–term gravel vegetation project at the BP Put River No. 1 drilling pad (1990). Contrast this empty site with its appearance in 1998 (Fig. 2). All photos are by Jay McKendrick unless otherwise noted.

Figure 2. View of vegetated gravel plot in 1998. This is the same area shown previously (Fig. 1) eight growing seasons after our first seed application. Indigenous plants introduced to test plots have naturally developed a functioning community with only one small application of fertilizer prior to seeding. Foreground plot was seeded to forbs. Middle plot was seeded primarily to grasses.

Figure 3. Arctic ground squirrel (Spermophilus parryii), a wildlife species that grazes on forage and harvests seeds from plants adapted to colonizing gravel fill.

Animal use on our gravel vegetation project plots, in the Prudhoe Bay Oil Field illustrate the point. Last year (1998) marked the eighth growing season for the first of our seedings in this study, which was described previously in *Agroborealis* (McKendrick, et al., 1992). The following narrative shows that as

Figure 4. After eight years, indigenous forbs seeded to test plots provided an aesthetically favorable contrast to adjacent barren gravel on the long–term gravel vegetation test plots at BP Put River No. 1 drilling pad, Prudhoe Bay, Alaska.

the developing plant community changed over time, shifts in animal uses occurred in concert with the vegetation progress (Figs. 1 & 2).

Our first seeding (1990) was dominated by alkaligrass (*Puccinellia langeana*). This lush stand of green forage immediately attracted grazing by arctic ground squirrels and geese. Geese grazed the new grasses early in spring, before snow melted from the surrounding tundra. The ground squirrels fed on the leaves throughout the growing season (Fig. 3). Because the stand was so dense, I feared no other plant species would have a chance to establish in those particular plots. The passage of time proved those fears were unfounded.

After two growing seasons, the alkaligrass and other grasses started producing seed stalks, and standing dead began accumulating. At that point, decline in geese grazing was dramatic. The ground squirrels burrowed into the gravel and remained. Ground squirrels harvested seed from the mature alkaligrass, northern tansy mustard (*Descurainia sophioides*), and other plant species, as well as continuing to feed on green foliage. As seed production from these and other plants commenced, Lapland longspur increased their visits to the plots. The alkaligrass began dying out in the fifth growing season, allowing other plant species a chance to dominate in its place. By the seventh year, the Lapland longspur were nesting in the plots.

For our second seeding (1991) we relied primarily on forbs (Fig. 4), particularly legumes, as a means to avoid the previous experience with alkaligrass. These plant species established much slower than the grasses, requiring five to seven years to reach sexual maturity. However, they proved far better suited to the pure gravel substrate than the grasses, which performed best where three–inches of silt loam had been applied. The handsome flowers produced by the paintbrush, oxytropes, milk–vetch, and sweet–vetch truly enhanced the aesthetics, in my view. The ground squirrels found the flowers of some species quite palatable, and in 1997, these animals devoured nearly every flower produced by nutzotin milk–vetch (*Astragalus nutzotinensis*). The following year, nutzotin milk–vetch flowers escaped the ground squirrels and produced seed in abundance (Fig. 5).

While this succession of plants and grazing animal uses was unfolding, fox and bear became increasingly interested in the plots, probably to seek the arctic ground squirrel. Were the area not fenced, caribou would have grazed the young grass seedlings, in concert with the geese. That co–mingling of grazing by those two animal species is quite common during the early stages of arctic revegetation. Their grazing pressures diminish sharply in three to five years, as the new grass stands matured, and began accumulating standing dead consisting of leaves and seed stalks. This standing dead is by no means lost habitat. A new milestone was reached in the eighth year of our study, when a king eider (Fig. 6) selected the standing dead cover provided by tufted hairgrass (*Deschampsia caespitosa*) for a successful nesting site (Fig. 7). Standing dead and litter are very important for bird nesting in the Arctic. Birds must nest in the Arctic well before the current–year vegetation production accumulates. Without the plant residue from prior years, many bird species would be

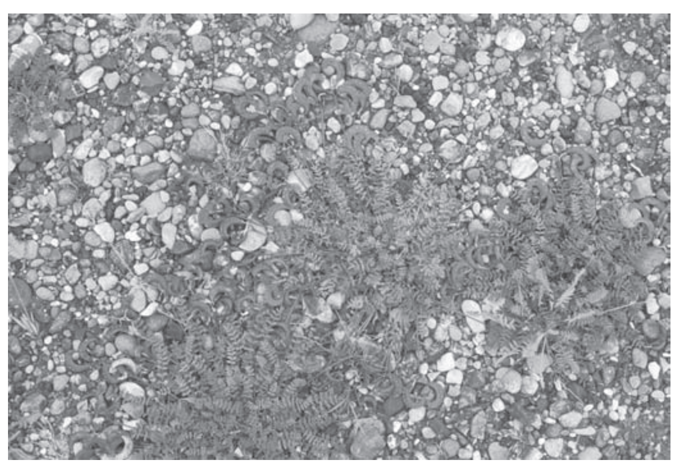

Figure 5. Nutozotin milk–vetch (Astragalus nutzotinensis) plants on gravel fill produced seedpods abundantly in 1998, five years after the species was seeded into gravel.

Figure 6. Male king eider (Somateris spectabilis) in Prudhoe Bay oil field. This duck species successfully nested in gravel vegetation test plots. Photo by John Warden provided courtesy of BPXA, Inc.

without suitable nesting materials and sites.

These anecdotal observations of vegetation and wildlife succession, on previously barren gravel fill, illustrate that the natural order and purpose within the arctic plant and animal kingdoms continues even within a producing oil field. Our experimental plots, though relatively small in comparison to the entire area of gravel fill in the oil fields proved valuable to indigenous animals, suggesting substantial benefits for wildlife populations can accrue as the oil fields are closed out and the gravel fill becomes vegetated. The objectives of this revegetation study were to determine the feasibility of using only natural plant species, as opposed to commercially available grasses, identify minimal treatments for improving habitat conditions to promote vegetation, and allow natural succession to proceed rather than cultural practices.

Acknowledgments

Appreciation is expressed to Lynn Noel and Steve R. Johnson of LGL Research Associates, Inc. for

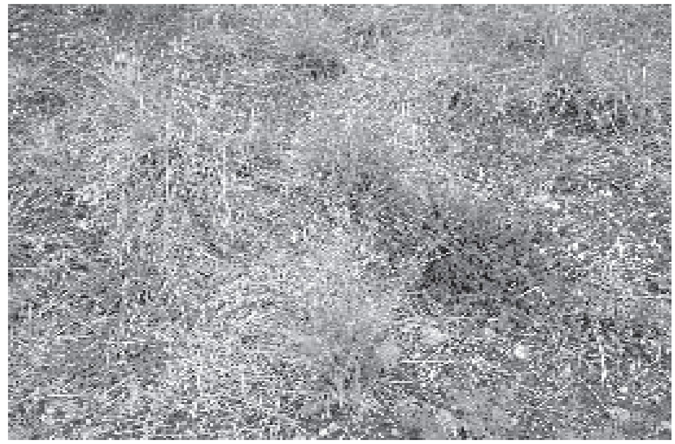

Figure 7. View of tufted hairgrass (Deschampsia caespitosa) clumps, their associated standing dead, and three indigenous legume plants. This shows the total biomass that accumulated over an eight–year period on one gravel vegetation experimental test plot, Prudhoe Bay oil field. A female king eider successfully nested among grass clumps near the center of this image.

identifying the king eider nest, and to Peg Banks for assisting with the vegetation sampling and analyses of these plots for several years. BPXA, Inc. funded the gravel revegetation research, provided in–kind logistical support for the field studies, and furnished the king eider photo for this article. Research support from the State of Alaska and U.S. Department of Agriculture (Cooperative State Research, Education, and Extension Service) provided salary for faculty and technical staff involved with this research. Other individuals variously involved with this study in alphabetical order include: Bill Baker, Nina Barbosa, Debra Beaubien, Anne Brown, Dan Cooley, Linda Perry Dwight, Eric Fiscus, Warren Fiscus, Maynard A. Fosberg, Michelle A. Gilders, Christopher J. Herlugson, Ray Jakcubczak, Amber Mayo, Daniel McKendrick, Jennifer Parnell, Peter C. Scorup, Conce Rock, Lee A. Sharp, Gwendo–lyn Turner, Anna Vascott, and Jeff Werner. Apologies are extended to any who were overlooked in my attempt to recall project participants from the previous nine years.

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NEWS, News, news

1998 Alaska woman in agriculture

Mrs. Evelyn Bush was honored on November 14, 1998 at the Alaska Agricultural Symposium as the years outstanding woman in agriculture. Mrs. Bush has run Bushes Bunches Farm and Greenhouse since 1956. She is an avid supporter of FFA and supports the Matanuska Valley community through her continued involvement in the Alaska State Fair, Pioneers of Alaska, the Alaska Rock Garden Society, and the Alaska Farm Bureau.

Mrs. Evelyn Bush receives her award.

Longevity Awards

The University of Alaska Fairbanks will honor those employees listed below for their service to the Agricultural and Forestry Experiment Station:

Rhonda Wadeson – 5 years
Michael Swanson – 5 years
Rudy Candler – 10 years
Gidget Wensel – 10 years
Thomas Malone – 15 years
Laurie Wilson – 20 years

UAF forestry curriculum is praised

The UAF forestry curriculum has received continued accreditation from the Society of American Foresters (SAF). Our program remains the only accredited four–year forestry program in the state. It is also one of only 48 programs in the U.S. qualified to award a professional forestry degree. Special praise was given by SAF for the integration of field experiences into the curriculum, despite the challenges presented by the harsh Alaska climate. The forest sciences department is located in the School of Agriculture and Land Resources Management.

SALRM assistant professor chairs UAF trails committee

Dr. Susan Todd was chosen to chair the UAF trails committee because of her experience as a mediator. Todd's senior level research planning class has already presented five alternative plans for the committee to consider in their deliberations. This semester, Todd's graduate–level planning class has been designing a master draft plan and holding public meetings to gather comments on the plan.

Dr. Susan Todd, left, teaches Natural Resources Conservation and Policy (NRM 101) and Resources Management Planning (NRM 430) during the Fall semester

"Who's, Who"

The reference "Who's Who among America's Teachers, 1998" will include our very own Dr. Charlie Knight. Dr. Knight teaches classes for the School of Agriculture and Land Resources Management— one very popular class is Soils and the Environment (NRM 380).

photo by Donna Gindle

Dr. Charlie Knight talks to farmers in Delta about barley planting dates and alternative crops.

Education Opens Doors to the Future

photo by Scott Penwell

Agricultural and Forestry Experiment Station faculty and staff provide educational opportunities for the Alaska public on an ongoing basis. These activities include presentations at seminars and professional meetings, mentoring K–12 students, volunteer work–to–learn programs, symposia participation, and individual meetings with constituents. Our faculty regularly publish information on their research projects in professional papers, the Agroborealis, AFES bulletins and circulars, and newsletters. This issue of the Agroborealis is about some of those educational opportunities.